WHAT WE OWE TO HUXLEY

DISCOVERY

A Monthly Popular Journal of Knowledge

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A LAMA FROM MONGOLIA

CONTENTS

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Edited by Hugh B. C. Pollard.

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Editorial Notes.

The North Pole is to be the fashionable resort this summer. No less than six expeditions are reported to be leaving as soon as the ice melts—or they can raise the money. Some are going on aeroplanes. Others prefer an airship. British, American, Norwegian and French nationals are engaged in a race. It seems rather a pity that some international authority could not regularize the sport by adopting a system of handicapping, worked out so that all the explorers would reach the winning Pole on the same day. Unfortunately, the axis of the Pole does not project, and a race in which the winning-post has to be located with sextant and theodolite is not unlikely to produce recriminations between competitors. There has been some fairly comprehensive Arctic lying in the past, but it is nothing to what we may expect under racing conditions. Each expedition means to plant a flag on the Pole. If the worst comes to the worst a fresh expedition can go out next year and carefully survey the ground, deciding by observation which flag was nearest to the actual Pole. It is, nevertheless, rather a glamorous Jules Vernian idea to fly an airship over the Pole, even if the scientific results of such an adventure are less tangible than plodding or sledging over the ice in the approved manner. It introduces a new element of speed and new dangers of mechanical breakdown which add to the perils of the explorers. One may question whether it is worth the risk, but, after all, that is purely a personal question. Some people have been at pains to prove that a human being can shoot Niagara Falls in a properly-constructed barrel, others dread even the cushioned amenities of European travel. There is a glamour about explorers that does not shine with such a radiance about discoverers. We can all name half a dozen intrepid explorers of the Arctic, yet who can, without looking it up, remember who discovered the use of chloroform as an anaesthetic? Few things have been a greater blessing to suffering humanity. On the other hand, celluloid heroes from the films receive civic welcomes and are apparently considered more important than real people. We must either revise our standard of values or begin to suspect that a halo of publicity is not the only test of the real value of an enterprise or an explorer.

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Milk is an almost universal article of diet, and it is also one of the happiest of media for a very wide range of undesirable bacteria. A pure milk supply is therefore extremely desirable, but not at all easy to secure. The Medical Research Council have issued a report on a new form of tuberculin test in cattle which is apparently reliable and easy to carry out. The old tests were not particularly trustworthy, and many errors could creep in. The new system depends on a small injection made between the layers rather than below the animal's skin. In uninfected cattle it produces only a small swelling, in tuberculous beasts it raises a substantial lump. The detection and elimination of tuberculous cattle leads directly to the reduction of cases of bovine tuberculosis in children, and prevention is better than cure. Modern conditions have brought about many new and difficult problems concerning our food supply, and it is generally admitted that we are behind other nations in the measure of hygienic precaution we force on our food retailers. An ordinary London butcher's shop with its attractive display of uncovered meat and delighted flies is, in the eyes of an American visitor, a shocking piece of mediæval irresponsibility. If they were privileged to see some of the mysteries of handling which occur between source and retailer they would

probably become confirmed vegetarians for so long as they stayed in the country. The trouble is that lack of elementary hygiene is not one of those vices which rouse people to the point of action. If dirty food was looked on as subversive of morals and butchers' shops could be raided there would be a marked improvement. Unfortunately, it is only a matter of national health, instead of being, as in the case of the night-clubs, a matter affecting a few thousand people who will go to low resorts in order to secure alcoholic relief from the boredom of their own personalities. Now, if a part of this virtuous public indignation could be focussed on some of the preventable iniquities of our food shops, something really useful might be done.

* * * * *

May is a wonderful month—the month of all the year for fieldwork by every kind of 'ologist, and it is really astonishing what a number of keen collectors and naturalists appear from nowhere in particular as soon as May sets its spell upon the countryside. They vary from working-men who are keen members of a local club to collectors with small motors to carry their field paraphernalia. Nature photography attracts many, pond-life others, botanists are perhaps fewer, but entomologists with particular specializations are the most numerous. They come out to the country from town and city and spend a day or a week-end amassing material. Sometimes the yield of specimens is phenomenal—something rare is found; more often there is nothing very notable, but I have never met a disappointed or dejected collector even if his bag of specimens is light. They always seem to have a good and thoroughly enjoyable day. Perhaps the object of the search may be as elusive as the gold at the rainbow's foot, but the pleasure of the day's search is a permanent, perpetual thing. It is rather a sterile triumph to a collector when his collection is complete. There is nothing more to be done. The soul of the thing has fled. He must find a new line, learn a new subject, or be that most miserable of men, one whose hobby-horse has left its stable. The attitude of the professional zoologist to the amateur fieldworker is sometimes misunderstood. From the academic point of view the amateur is merely a collector or contributor of material which he knows very little about. On the other hand, you find belligerent field-workers who know their subjects extremely well who contend that the academic authority is based solely on access to works of reference and type specimens, and that the seat of true learning and observation is in the open air rather than pickled in formalin. This battle will always go on, but actually both are dependent on one another. There appears to be room for greater co-operation between the amateur workers and the professional. Last month we printed an article by Dr. Stephenson, of the Zoology Department of the University of London. He requires sea anemones. There must be many other subjects under investigation for which material is wanted where collectors and amateurs would be only too pleased to help. The pages of *Discovery* are open to anyone who wishes to enlist volunteer help for any scientific work, from zoology to archæological excavation. There is a great deal to be done which could be done if volunteer effort were co-ordinated under skilled direction.

ROYAL SOCIETY OF ARTS.

ARRANGEMENTS for meetings from May to end of Session :—

Monday, 4th May, 8 p.m. (Howard Lecture).—Professor John S. S. Brame, F.I.C., F.C.S., late President of the Institution of Petroleum Technologists: "Motor Fuels." (Lecture III).

Wednesday, 6th May, 8 p.m. (Ordinary Meeting).—Air Vice-Marshal Sir William Sefton Brancker, K.C.B., A.F.C., Director of Civil Aviation, Air Ministry: "Commercial Aviation." His Grace the Duke of Sutherland will preside.

Friday, 8th May, 4.30 p.m. (Indian Section).—Sir Gilbert T. Walker, C.S.I., M.A., F.R.S.: "Indian Meteorology."

Wednesday, 13th May, 8 p.m. (Joint Meeting of the Royal Society of Arts, the Royal Aeronautical Society, and the Anglo-Batavian Society).—Thomassen A. Thuessink van der Hoop: "The Non-Stop Flight to the Netherlands East Indies." Air Vice-Marshal Sir William Sefton Brancker, K.C.B., A.F.C., will preside.

Wednesday, 20th May, 8 p.m. (Ordinary Meeting).—Professor John Ambrose Fleming, M.A., D.Sc., F.R.S.: "William Sturgeon and the Centenary of the Electromagnet." Alan A. Campbell Swinton, F.R.S., late Chairman of the Council of the Society, will preside.

Friday, 22nd May, 4.30 p.m. (Indian Section).—Sir Alfred Chatterton, C.I.E., B.Sc.: "The Industrial Progress of the Mysore State."

Friday, 12th June, 4.30 p.m. (Indian Section).—Brigadier-General Sir Percy M. Sykes, K.C.I.E., C.B., C.M.G.: "The Heart of Asia and the Roof of the World."

Thursday, 18th June, 4.30 p.m. (Dominions and Colonies Section).—Hon. W. G. A. Ormsby-Gore, M.P., Under Secretary of State for the Colonies: "East Africa."

Long Chances in Nature Photography.

By H. Mortimer Batten, F.Z.S.

(*Author of " Prints from Many Trails," " The Badger Afield and Underground,' " Inland Birds," " Habits and Characters of British Wild Animals," etc.*)

There are few more difficult subjects than wild-nature photography, but it provides one of the most absorbing of sports. This article tells how the pictures shown were secured.

JUST as every sportsman remembers, and recalls in his moods of happy retrospect, his long chances, so does the man who shoots with a camera in place of shot and powder. The writer was brought up to the shot-gun and rifle, but since he took up the camera, to which everything on wings or legs is game and nearly everybody's property a free preserve, it is surprising how the lure of the high explosive has faded. Time was when I—pardon the sudden abandonment of the unwieldy third person—loved with a very great love a day among the grouse or the pheasants, or even among the rabbits, but since I took to wild-life photography, nothing in the shooting line is very alluring—except when the woodcock are in, or the red deer down in the corries, or when the surroundings are such that the whistle of wings above the rushes adds an ulterior charm to the actual killing of game. Infinitely would I prefer to sneak away all on my own with a camera and an electric outfit and a pair of field-glasses—to shoot something whereby a permanent record is obtained and no blood spilt.

There are two kinds of electric photography—or rather one kind, which is adaptable as regards mode of procedure. Either you can place the camera and go right away, leaving the wild subject to photograph itself—thrilling, because you never know what you are going to find on the plate ; or you can lie at the end of a length of wire with binoculars, and press the button at the crucial moment (you rarely hit it). Again, you can leave your camera fixed over-night, and going round next morning you see at a glance whether the charge of magnesium powder has been exploded. Then, indeed, you do not know what is on the plate, and while you sit in the dark room waiting for the image to appear, your thrills are at least equal to those which possess the crouching sportsman who, rifle ready, waits for the grass to part.

Catching a Weasel.

Among the memories of my long chances in wild-life photography ranks the first photograph I ever took of a wild weasel. I realize now that it is far from being a perfect photograph, for in the first place the subject has shown the bad taste of turning his face from the camera. There is no gleam of eye, no high light to speak of, but still it is a good picture in view of the unbelievable difficulties in obtaining pictures of any kind of those beasts which move like greased lightning and habitually eschew the open light.

Walking down the shores of Loch Ken one February morning, I noticed two grey crows evidently feeding on something on a pine headland. As I drew near, the birds flew off, and going up to investigate I found a disembowelled rabbit. Apparently it had been killed by a stoat or a weasel, and that within thirty minutes of my arrival, for the body was still warm. It looked, indeed, very much as though the sabre-billed ruffians might have driven the rightful huntsman away to appropriate the kill for themselves, and it was by no means unlikely that the real killer was in the rocks, and watching me even now.

Four Days' Wait.

The lay of the land was not easy—it never is—but it took but a few minutes to rig up the camera and fix the contact plate alongside the kill. A photograph of the grey crows would be worth having, but I did not expect them to return, since doubtless they were watching me, and would suspect me of fixing a trap. But I might get something else worth while, though I gravely feared the house rats, which were numerous along the loch margin, would leave their ugly impressions on the plate.

At sundown nothing had happened, so the camera was switched off, to be reconnected next morning. That day nothing happened, nor the next after that, save that the weather was vile, but on the evening of the fourth day I found on going up that the rabbit had been dragged several yards. Yes, and there was the white disc, indicating that the shutter had been released by its magnetically tripped operating arm—by a sheep-dog, I told myself, if not by one of those eternal house rats !

It is surprising how, in wild-nature photography, one learns to curb one's expectations, but all the same I lost no time in gaining the dark room, with the result here shown. The weasel which had made the kill—presumably—had returned three days later,

WEASEL, RETURNED TO A KILL MADE THREE DAYS PREVIOUSLY.

probably having ascertained in the interval that the grey crows had left it for good. For the grey crow is a very able fighter. Even the weasel recognizes that.

Trolling for pike one day, I noticed a bird bathing in the shallow water just where the river entered the loch, and as I watched, it spread its wings and rose lightly on to the point of a dead tree lying at an angle at the water's edge. It was clearly a peregrine falcon, doubtless one of the two which habitually hunted the north end of the loch, and later one of the boatmen told me that he regularly saw the bird bathing at that place, or drying out its feathers on the stump near by. There was therefore a chance—how long a chance only those who know the chances of wild-life photography can appreciate—of obtaining his likeness, and I realized that it might take a long, long time.

Simple Apparatus.

Raking out an old fixed-focus camera (the regular outfit being in use) I made an exceedingly primitive electric shutter release out of such materials as were available in that remote locality, namely, an old clock, an old lock, an electric bell, and a cigar box, fixed up the camera commanding the entire length of the reclining tree, and having fixed wire contact points to the extremity of each pinnacle on which the falcon might alight, I went away and to all intents and purposes forgot the possibilities. Two or three mornings later the boatman told me that he had again seen the falcon bathing, so away we went to ascertain our luck. Imagine my surprise on finding that the primitive electric outfit had worked, that the shutter had worked and—later—that the wild subject was actually facing the camera! The result is reproduced herewith. It has, of course, been much enlarged.

Later that season I procured several good photographs with the same ramshackle outfit, far better, on the whole, than I got with my more recent and infinitely more costly kit, which goes to show that results are by no means determined by one's out-of-pocket expenditure. Incidentally, two of the most successful bird photographers I know use pre-war cameras which cost less than £5 complete. My best photographs have nearly all been taken with a whole-plate lens which cost 30s. new thirteen years ago.

Bagder-Baiting.

There are very few photographs in existence of wild badgers taken in a state of perfect freedom. One of the few is reproduced on the next page. While visiting some friends in the south of Scotland, the keeper told me that there was a family of badger cubs in a wood near the house. Moreover, he was sure that the cubs came out in broad daylight on occasions, as he had repeatedly seen where they had rooted up the leaves. Normally the badger is so shy and so strictly nocturnal in its habits that as a subject for the photographer he is practically impossible.

Visiting the badger warren with our pockets full of raisins, I and my host buried little stores of raisins under the leaves all about the warren. Four hours later we saw that the cubs—presumably—had been out, and rooted up every yard in search of the raisins. Accordingly more delicacies were hidden the second day, but the only camera I had with me was a postcard Kodak. This was tied to a branch, and a cotton stretched across the patch where most of the raisins were buried. By breaking the cotton the badgers (we hoped) would release the shutter.

Within two hours of fixing the camera we obtained the photograph here shown. It was specially welcome because the two adult badgers—the parents, not the cubs—are shown searching for the hidden treasure. Evidently they had discovered the desirable feast, and instructing the cubs that raisins were not good for boys and girls, they were themselves trespassing upon the daylight to see that nothing was wasted.

This was an unexpected scoop, so I promptly wired home for my full outfit, which arrived next morning. No good, alas! The badgers had evidently decided that mankind was beginning to take too much interest in their secluded corner of the wood, for they had forsaken the warren.

Animal Expression.

The photograph of a vixen shown on the cover of DISCOVERY last month is rather remarkable because it is evident that the shutter clicked the very instant her suspicions were roused by the presence of the camera. Probably she saw the gleam of the lens, and very clearly she is just in the act of drawing back—ready to flee or to show her fangs. I spent the whole of one spring photographing foxes, exposing in all about a dozen plates, only three or four of which are really worthy of reproduction. The fox is one of the most difficult subjects we have, for it is inevitably a case of flashlight, and flashlight photographs on a rapidly moving object are, to say the least, uncertain.

THE PEREGRINE FALCON WHO PHOTOGRAPHED HIMSELF.

BADGER FAMILY GRUBBING FOR THE BAIT.

A dead cat, distinctly on the gamey side, is the best bait for a fox, for he will parade round it several times in narrowing circles; but one must first know exactly where the foxes are and which way they go. He is difficult enough to trap, but infinitely more difficult to photograph, for the faintest whiff of man or sign of man's recent presence will send him ricochetting over the hills; and not only will he not return himself, but you may bank upon it that no other fox in that locality will return. Hard work, close study, and inexhaustible patience and perseverance, are necessary for fox-hunting of this kind, and when at length a photograph is obtained, one is generally called upon to endure the mortification of having it turned down by the illustrated weeklies with the comment, "Not sufficiently clear!" Gad! if the public only knew what a photograph of such a subject really means, they would pardon a slight absence of definition; but in these days nature photographs for reproduction must be clear enough and sharp enough to stand almost unlimited enlargement.

Family Studies.

The photograph of the two squirrels, the gentleman gnawing a hazel in the foreground, and the lady doing the same thing in the background, is one which I value simply because it took an enormous amount of getting. The two squirrels had their larder under a slab of rock a foot or two below the log of wood on which the lower squirrel is seated, and seeing them day after day about this place, I decided, as soon as the light was sufficiently strong, to try to photograph them. Thereafter

I saw to it that they need not travel far beyond the field of the camera in their search for nuts, yet days passed before I succeeded in getting the pair of them on one plate. I could have photographed either of them singly a dozen times a day, but when they came together, they were always so far apart that only one or, more generally, neither was within the field of focus. I recollect well that one second after I had pressed the button and obtained the result here reproduced, the female squirrel (above) startled by the shutter, pricked her ears, then promptly came down and posed beautifully on the end of the log on which her husband is shown! Thus one could have covered them both under a soup plate making a beautiful picture.

TWO SQUIRRELS ON ONE PLATE.
An extremely difficult subject.

But though in wild-nature photography there are many failures for every result worth having, one learns so much about the habits and characters of one's wild subjects that the sensitive plate of one's memory acquires a collection no less valuable than those the camera affords. Above all, it teaches us how wild life is designed to intermingle with its chosen background — often so perfectly that in the photograph the "wild life" is indistinguishable from the background!

I personally have picked up more dramas of the wild and learnt more about the inner lives of birds and beasts by trying to photograph them – sometimes with distinguished failure—than by any other means. The man who carries a gun may in time accumulate a great assortment of facts, but normally he sees little or nothing of the wild, free, natural life for which the photographer waits and watches. Wind and storm and torrent, the long hill tramp after the sun is gone, great lonely places and paths which are sometimes perilous, are the lot of both, and of this I am sure—that no man who truly loves the gun would turn aside from the charms of the camera were time and circumstance with him.

TOMATO DYE.

Do fresh tomatoes contain coal-tar dyes? It seems very probable, since they answer to the same chemical tests. This fact was recently discovered when the Argentine government refused to allow the landing of a consignment of tomato sauce, which gave the same chemical reactions as coal-tar artificial dyes. Reference to an expert analyst confirmed the finding, but the manufacturers of the sauce denied using any coal-tar derivatives whatsoever, and gave the fullest details of the methods by which they prepared the sauce. As a last effort to discover the truth the same tests were applied to fresh raw tomatoes, and it was discovered that they too gave the same reactions. Whether the Argentine government relented or not is not told, but the analyst puts forward the suggestion that chemists may assume, if a tomato sauce does not appear to contain coal-tar dyes, no tomatoes have been used in making it, and it is not entitled to be called tomato sauce.

IN the article on "Plant Soil and Climate" in our issue for April, it was inadvertently stated that the Oden-Keen Balance was made by Messrs. Gallenkamp. The actual manufacturers are the Cambridge Instrument Company.

Cavemen in Derbyshire.

By E. N. Fallaize, B.A.

During the season further archaeological exploration of the Creswell Crags site will be carried out. It is impossible to predict results, but it is probable that very important material will be found.

IMPORTANT discoveries relating to early man in Britain by a joint committee of the British Association and the Royal Anthropological Institute for exploring caves in Derbyshire were reported recently. Excavations made by Mr. G. A. Garfitt and Mr. Leslie Armstrong, chairman and secretary of the committee, have brought to light in a rock shelter at Creswell Crags an undisturbed site which must have been first occupied very nearly at the beginning of the Palaeolithic or Old Stone Age. In the lowest and, therefore, earliest deposits were found a large number of flint flakes and implements made from quartzite pebbles, which resemble the very early implements known to archaeologists as Acheulean, so called from the type implements found at St. Acheul in France. Mingled with them were fragments of bones of animals now extinct or no longer found in Britain—the cave lion, cave bear, rhinoceros, mammoth, and hyena. This discovery marks the most northerly point to which it has as yet been proved that early Palaeolithic man extended in this country. This is a matter of considerable interest, as this period falls within the Ice Age when the north of these islands was covered by an ice cap, and was, therefore, inaccessible.

Ice Age Interval.

After this early occupation a very long period elapsed before man again lived on the site. The implements found in the cave-earth above the earliest deposits belong to the much later phase of the Palaeolithic period known as the Upper Aurignacian, their resemblance to type examples from Aurignac, whence this culture takes its name, and elsewhere in France justifying the attribution of this date. Of the Mousterian and Lower Aurignacian cultures, which fall chronologically between the Acheulian period and the Upper Aurignacian in the classification of remains of palaeolithic age, little if any evidence was found. The reason for this lengthy gap must be sought in the advance of the ice cap, which in the earlier period prevented the penetration of early man farther north, to a line south of Derbyshire. When it receded, this site was again made accessible for occupation.

Among the remains of the Upper Aurignacian period a remarkable discovery was made. Three fragments of bone were found on which were engravings similar to those which have been found in numbers in caves in France. One showed a spirited drawing of a reindeer, another of part of a bison with the head, but the third was on a fragment of bone too small to allow of identification. Such engravings are extremely rare in this country, and not all for which a high antiquity has been claimed have been accepted as authentic. The best known and the only unquestioned engraving from a cave in this country is a horse's head on bone found by Sir W. Boyd Dawkins in 1876 in the Robin Hood Cave, also at Creswell. Mr. Armstrong himself found engravings in a workshop site at Grime's Graves in Suffolk in 1921.

Culture Problems.

At the base of the section was a hearth consisting of a hollow scooped out in the floor and surrounded with flat stones. Around this were bones which had been split for the marrow, stones which had been used in cooking, and a large number of implements of flint and bone as well as fragments of mammoth ivory and reindeer antler.

The evidence shows that from Upper Aurignacian times occupation was continuous until the Azilio-Tardenoisian period, the period which marks the transition from the Old Stone Age to the New, of which a characteristic tool is the pygmy flint implement. It is a remarkable fact that the implements found in the deposits which extend over this period of continuous occupation show that its culture developed independently. There is no sign of the intrusion of the Magdalenian culture, so called from the cave of La Madeleine in S. France, which succeeded the Aurignacian culture on the Continent at the end of the Palaeolithic period. It thus supports a suggestion put forward by certain archaeologists that a true Magdalenian culture is not found in England. On the other hand, the pygmy implements of the Azilio-Tardenoisian culture from this site are comparable with the pygmy industries of the Pennines and South Yorkshire, which, in one phase at least, are practically identical with those of the Tardenois culture in Belgium.

A NEW reptile fossil of lizard type is reported from the Permian rocks of Madagascar. It is similar to the *Broomias* of South Africa, and has been named *Broomia Madagascariensis.*

Bushman Arrow Poisons.

By I. Schapera, B.A.

The very primitive races still have secrets which modern science is only slowly solving. The curious mixture of poisons used by the Bushmen is now being accurately investigated. The researches may lead not only to exact knowledge of the poisons used, but to the discovery of an antidote or drugs of possible value in the fight against disease.

THE Bushmen of South Africa, now almost extinct, are typical representatives of a people living in one of the most primitive forms of social organization known to us. Split up into small family groups, they roam about the desert tracts to which they have been confined by the encroachment of more powerful races, eking out a precarious subsistence from the edible roots of the veld and such game as they are fortunate enough to come across. The Bushman's whole life is one long struggle for existence—the greatest problem he has to face is that of providing food for his family and himself, and it is largely upon his success in the chase that he relies for this.

Peculiar Arrows.

His only weapons are the bow and arrow; traps and snares are occasionally used to waylay the game, but in the main he relies on the efficacy of his poisoned arrow. The Bushman's bow is one of the simplest known in the world; it consists merely of a bent piece of wood (usually *Irevia flava*), about three feet long, with a string of animal sinew. The arrow, on the other hand, is very complex. It consists of three distinct and separable parts. The main shaft is a slender reed about a foot long, neatly bound round with sinew at each end to prevent it from splitting, and notched at the butt end for the string. Inserted at the other end is the foreshaft, usually of bone, which is cut off square at the end, where a groove or notch about an eighth of an inch deep is cut. Into this notch is fitted the triangular head of the arrow, which was originally made of stone, bone, or wood, but more recently of iron, and is held in place with a gum of euphorbia juice. About an inch and a half from the head a piece of quill is usually so fixed in the foreshaft as to act as a barb, and prevent the arrow from falling out of the wound. It is kept in place with a binding of sinew. All this portion of the foreshaft, as well as the head of the arrow, is carefully covered with the poison, which is smeared over the sinew bindings and afterwards rubbed down level and smoothed all round, so that the arrow penetrates more easily into the flesh.

The fragile and slender arrow of the Bushmen by itself can never seriously harm any animal which it strikes, and hence it is obvious that they depend entirely on the effect of the poison. It can safely be said that all the Bushman tribes, without exception, make use of poisonous mixtures which they smear on their arrow-heads. Many ingredients of different kinds are used for this purpose, of which the commonest are the vegetable juices of *Acokanthera venenata*, *Haemanthus toxicana* or *Amaryllis distichia*, and various species of *Euphorbia*; the venom of the larger poisonous snakes, such as the puff-adder (*Echidna arietans*) and cobra (*Naja haje*); the grubs *Diamphidia simplex* and *Blepherida evanida*; the "baviaan-spinnekop" or trap-door spider; and the "klip-gift" or "rock poison" (probably a form of arsenic). Not all of these are in use among the Bushmen as a whole, however; there appears to be a fairly definite distribution of the various mixtures, dependent on the substances available in the different localities, and probably each little group of Bushmen has its own particular formula, though this cannot be said definitely. For general purposes we may distinguish two main types of arrow poison: the southern Bushmen, inhabiting the Cape Colony and neighbouring regions, use either a vegetable juice by itself, or, more frequently, mix it with snake poison; while the central and northern tribes, inhabiting the Kalahari Desert, Southern Rhodesia, and the South-west Africa Protectorate, use the grub or chrysalis of the *Diamphidia simplex* (the *'Nga* of Livingstone).

Two Poison Groups.

The method of preparing the first type of poison is to cut off the head of the snake, extract the poison sacs, dry them, and pound them into a dust. This is then placed in a piece of ostrich eggshell or the breastbone of an ostrich, and the vegetable juice is poured in and the mixture stirred with a piece of bone or stick. It is then boiled until it acquires the requisite degree of consistency, usually that of a thick jelly, brownish-red in colour. Where a purely vegetable substance is used, as in the case of the *Acokanthera* shrub, the method of preparation differs but slightly. The wood of the shrub is pounded into a rough powder, which is put into a clay pot and boiled for some time. A lid is kept on, as the fumes are noxious,

but the liquid is stirred occasionally. After a while the wood is taken out and the remainder allowed to simmer until it is reduced to a cupful of glutinous fluid. This is then taken to a *Euphorbia* tree, and mixed with the fresh milky sap drawn from its stem. The poison is then ready for use. It is a brownish substance similar in appearance to beeswax. The poison is generally worked up into a lump, which, when not wanted for immediate use, is carried about, wrapped up in a bit of skin, in the long bag which every Bushman carries. When the poison is required, the lump is heated in a bit of tortoise-shell, and the melted portion either smeared on the arrow-head with a brush of wood or bone, or else placed in a "poison-stone," a smooth flat pebble with a deep groove down the middle to hold the poison. The part of the arrow to be anointed is pressed down upon this and worked round and round until the poison coating has acquired the proper shape. If possible, the poison is never touched with the fingers, and great care is taken that none adheres to the hands or nails during the process.

Grub Poisons.

The insect *Diamphidia simplex* which forms the main ingredient of the second type of poison is a small green beetle which frequents certain bushes (*Commiphora dinteri Engl.*) in early spring. The grubs come out in summer, eat the leaves of the bushes and crawl into the sand beneath them, where they form cocoons. In both these stages they are used as poison, but the cocoon is preferred. It is dried in the sun and can then be kept some time and easily transported. The insect inside is rubbed to powder on a half tortoise-shell, then mixed with juice obtained either from the spiked cucumber (*citrullus caffer*) or from the "hakdoom" (*zisyphus micronata*). The cucumber root is heated, knocked on the ground, then wrung out into the dish of poison. The bark of the "hakdoom" is chewed, and the juice spat into the poison. This juice is clear, bitter and sticky, and adheres to the arrow-point on to which it is dabbed with a flattened stick after being mixed with the poison. The poisonous matter becomes very hard and dry, and is apt to fly off into the eyes if the arrow is handled carelessly.

BUSHMAN.
Pure type from Griqualand West, using bow and arrow.
(*By Courtesy of Man*).

Any mixture left over is wound on to a stick and carried with the arrows in the long bag. It must be heated again if it is to be put on further arrow-heads.*

There does not appear to be any sort of ceremonial attached to the process of preparing the poison, nor is the function of preparing the poison limited to any special persons. There are, indeed, one or two hints at something of this kind scattered about in the vast amount of literature dealing with the Bushmen, but there is nothing at all that can be regarded as definitely reliable. Miss D. F. Bleek, one of the greatest authorities on the Bushmen, tells me that as far as she knows any Bushman who needs poison prepares it for himself when he wants it, and this statement is supported by other authorities.

Action.

The poison seems to be most effective when it is fresh, and the older it gets the less active does it get. The length of time for which it remains potent is doubtful, and varies with the nature of the ingredients. Stigand was informed by the Lake Uganii Bushmen that the poison of the *Diamphidia* grub remains active for about two years, and that they can tell whether the poison on an arrow head is active by simply smelling it. Lewin, on the other hand, succeeded in determining the active principle in the poison on some arrows brought to Germany in 1806 by Lichtenstein, and found that after a hundred years it had not changed either chemically or toxically.

None of the Bushman poisons is instantaneous in its effect though, generally, the smaller the animal the quicker the action. Usually the wounded animal runs on as if unhurt, and the hunter follows on its spoor until he finds the dead body; sometimes this is within half an hour, sometimes many hours elapse before the poison proves effective, and often enough it is not till the next day that he can obtain his meat. That the poison, once it gets to the blood, is fatal, cannot be doubted; once the arrow pierces the skin of the animal the Bushman has no fear that it may escape him; it may travel perhaps forty or even seventy miles after being wounded, but its progress

* From information kindly supplied by Miss D. F. Bleek.

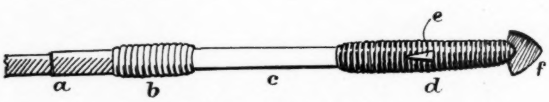
becomes slower and weaker, until finally it falls down dead. On human beings the effect, however, does not always seem to have been fatal, though if the wound was on the upper part of the body there was usually no escape. The poison took a long time to act, and was exceedingly painful, as is described by Campbell and Andersson.

The meat of the animal thus killed is quite eatable, as is to be expected, seeing that it was killed in order to provide food for the hunter. The taste is described as peculiar and slightly sweetish, but not unpleasant. After a day or two, however, the carcass swells and the meat putrefies. As regards the flesh surrounding the wound, some writers say this is not poisonous; Chapman, indeed, states that the Bushmen have a great preference for that part of the flesh where the wound has been inflicted, calling it *nice* and *salt*. Generally, however, the flesh around the wound is cut away, as far as it is discoloured. The rest is eaten with impunity.

Physiological Effects.

A few notes on the pharmacological properties of some of the poisons may not be out of place.

Lewin, analysing the poison on the arrows brought to Germany by Lichtenstein, found that the active principle was an alkaloid which he termed *Haemanthin*, and is derived from the bulb *Amaryllis distiebia*. When a solution of this was injected into doves and rabbits it produced dilation of the pupil of the eye and an almost never absent stimulation of retching. The most important expression of toxic energy was a decrease in stimulation of the central nervous system which, among other things, led to a cessation of motor activity and to a condition of drowsiness. Larger quantities caused severe interruption of breathing, which culminated in death. The addition of euphorbia juice did not strengthen the effect of this poison, thus confirming the general opinion that this juice was used merely to cause the poison to adhere more easily to the arrow. When, however, snake poison is added, the result is to produce an effect synergetic in regard to interruption of breathing. Dr. Juritz has experimented with this poison in his investigations on South African plant poisons, and writes of it as follows: "The active principle appears to be an alkaloid, and is contained in the fresh bulb to the extent of nearly four per cent, imparting to it a slightly bitter taste. One drop of the acidulated aqueous solution killed a young mouse in three minutes, a much larger mouse being killed by two drops in five minutes. The symptoms observed were—at first restlessness, then muscular twitchings, and finally alternating violent muscular contractions and relaxations. The hearts were found to be somewhat pale but not contracted, and contained much blood. The liver was practically normal, though pale, and the intestines much contracted and twisted. An aqueous extract, representing thirty-five grains of the dried and powdered bulb, administered to a healthy dog seven months old, produced restlessness in fifteen minutes, excitement of the sensory nerves, considerable acceleration of the pulse, and chronic convulsions. Gradual recovery then took place, and on the day following the dog appeared quite well again. After two days another dose, equal to fifty grains of the dried bulb, was administered. Within ten minutes anxious restlessness ensued, followed by sudden shivering and muscular twitchings; forty-five minutes after the administration of the dose alternate paroxysms of convulsions and intervals of quiet ensued, the dog seeming at times to be on the point of death from asphyxia through rigidity of the respiratory muscles. From this stage recovery gradually took place, health being apparently restored by the next day, although great weakness prevailed. A larger dose would doubtless have been fatal. The active principle in this bulb evidently belongs to the excito-motor class, closely resembling nux vomica. The alkaloid seems to present a closer similarity in its physiological action to brucine than to strychnine, differing, however, from both in its chemical reaction."



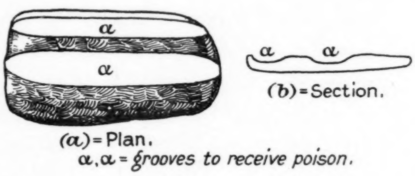
BUSHMAN ARROW (after Stow).

a—Main shaft of reed; *b*—Sinew binding between main and fore-shaft; *c*—Fore-shaft of bone; *d*—Sinew binding on fore-shaft covered with poison; *e*—Barb of quill; *f*—Iron head of arrow.

To the same investigator we are indebted for an account of the action of *Acokanthera venenata*, which forms an important ingredient of the poison mixtures of the southern Bushman tribes. He finds that "the plant contained an active principle of violent action, and that, when administered to anyone suffering from a weak heart, fatal consequences might ensue. It was concluded from the peculiar action of the plant, and its bitter taste, that it probably contained a glucoside possessing very violent emetic properties, emesis being accompanied by severe straining, and apparently affecting carnivorous animals more seriously than those which are herbivorous." The active principles are extremely like those of digitalis. It has a primary slowing and strengthening effect on the heart, which quickly passes into a toxic effect, leaving the heart quiescent in systole. When injected intravenously

it has a pressor effect, and on all plain muscle its effect is contractile.

The poison grub (*Diamphidia simplex*) used by the northern and central Bushmen has been investigated recently by Lewin. He finds that the poisonous material resides in a yolky mass which, however, he does not define. After the subcutaneous introduction of solutions of the yolk-bodies isolated from the larva of this grub, disturbances of motor activity occur quite rapidly in the case of animals. Food is no longer digested ; retching and diarrhoea ensue. The animals become restful and crouch motionless ; the eyelids, which for a time flickered almost incessantly, at length take part in the general inhibition of motor activity. The eyes are closed, and the animals fall into a condition of paralysis, and perish only after many hours of impeded respiration. He adds that, unlike the vegetable and snake poison, the desired effect does not take place quickly, at least, so quickly that the victim is easily obtained. Many hours, and even days, must the hunter follow the track of the animal before he can take possession of it. Later investigations have shown that the active principle here is a toxalbumin, which acts on the red corpuscles



BUSHMAN "POISON STONE."

of the blood, producing haematolytic changes involving the dissolution of the haemoglobin. The symptoms of the poison were paralysis, followed by death.

It is a remarkable fact that the poisons used by the Bushman should all have such very marked toxic effects, and this suggests that there must have been a long period of experimentation with the different substances available before the most effective should have been hit upon.

Search for Antidote.

There remains to discuss the question of antidotes. As far as is known the southern Bushmen carried no specific antidotes to their arrow poisons, and knew of none. Although they undoubtedly had methods of inoculating themselves against snake poison, these cannot be regarded as antidotes in the sense of a specific medicine used to counteract the effects of poisoning from an arrow wound. As regards the northern Bushmen, much prominence has been given by later writers on the Bushmen to Chapman's statement that he had discovered the antidote to the poison grub used by them. This he described as a plant with long, thick, narrow, pulpy and lanceolate leaves, which have a strong indentation down the middle and are dull green in colour. This plant, called *Kala hustle* by the Bechwana, bears small five-petalled flowers with two sepals only. Its root was chewed and rubbed on the scarified wound, to which grease was afterwards applied. This plant, unfortunately, has not yet been identified, nor has Chapman's statement been corroborated. There is, therefore, no reliable evidence that the Bushmen ever used antidotes for their poisons, nor do they even seem to be aware of any antidotes. This is one among many other points that can only be decided by careful investigation in the field.

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HOW REAL PEARLS ARE TOLD.

JAPANESE pearls formed by an oyster round a nucleus of mother-of-pearl can now be definitely told from real pearls by spectrography with monochromatic X-ray waves. The mother-of-pearl centre in the Japanese pearls produces a definite figure arrangement not unlike the Lane figures, while the real pearl shows a definite unstriated series of rings. The difference between the simple structure of the true pearl and the double structure of the Japanese-grown pearl can be immediately recognized.

mainly with the improvement of soil-texture or "tilth"; although itself containing a quantity of plant-nutrients in a temporarily unavailable form.

The three manurial substances which a soil, *per se*, is unable to supply in available quantity are, firstly, nitrogen ; secondly, potash ; and, lastly, phosphoric acid. An average sample of farmyard manure contains these constituents in the following proportions :—*

Nitrogen	.66%
Phosphoric acid	.25%
Potash	.33%

The smallness of these quantities may lead to some doubt as to the value of such manure, yet a simple calculation will show that the figures are not so inconsiderable as might have been imagined. Accepting the above analysis, it will be seen that, in applying a normal dressing of 10 tons per acre, we are supplying to every acre of ground 150 lb. of nitrogen, 55 lb. of phosphoric acid, and 75 lb. of potash. A 16-ton crop of swede-turnips removes from the soil, per acre, approximately 100 lb. of nitrogen, 22 lb. of phosphoric acid, and 80 lb. of potash.

Rotation.

This is not all obtained from the season's application of farmyard manure. Even in the much simplified form of animal excreta, many of the plant-nutrients

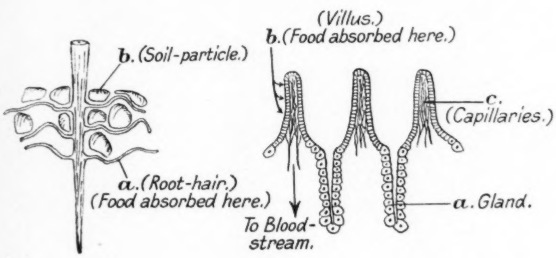

FIG. 1.

A.—ROOT HAIRS OF SEEDLING (diagrammatic).

B.—FRACTIONAL PORTION OF LINING OF THE SMALL INTESTINE. (transverse section, diagrammatic). To avoid confusion, capillaries are shown only in the villi.

The above diagrams are highly magnified, and illustrate the analogy between plant- and animal-digestion. The *root-hairs* (*a*) Fig. 1A, of a plant ramify between the minutest soil-particles (*b*) and draw, from their surfaces, water together with dissolved food materials. Solution of food is assisted by organic acids (cf. digestive juices) exuded by the root itself.

Within the plant-body these materials are built up into complex substances which are eaten by an animal, and whose fate is illustrated in Fig. 1B.

The *glands* (*a*) exude digestive juices. These act upon the food in such a way that it may be absorbed by the innumerable, finger-like processes known as *villi* (*b*). Thence it is either transferred in a state of solution to the capillaries (*c*), and is eventually led into the main blood-stream, or, in the case of fats, is first discharged as an *emulsion* into the lymphatic system. Those nutrients, however, which an animal will return to the soil as farmyard manure, pass directly into the blood. The villus of an animal may therefore be roughly compared to the root-hair of a plant, with the notable reservation that the latter is composed of a single cell, while the former comprises a very large number of such absorbing-units.

have to undergo further change in the soil before they can be absorbed by the plant, and it thus occurs that a certain proportion of such constituents becomes available only in succeeding years after application. Under a popular system of farming known as the "Four-course rotation," farmyard manure is applied once in four years—to the root-crop. Roots are grown, on a given field, every fourth year ; and the intermediate seasons are for various reasons devoted to other types of crop.

* Sir A. D. Hall, "Fertilizers and Manures."

The fertilizing value of a dressing of manure is spread over a large portion of the intervening period, and is assisted by the natural resources of the soil, which are also gradually being simplified—chiefly by the action of bacteria. In addition to these sources of nutriment, the modern farmer finds it necessary to supplement by the application of "artificial fertilizers," but a discussion of mineral and synthetic plant-foods is beyond the scope of the present article.

Ammonia.

Plants take in their nitrogen in the form of nitrate, and it is to this form that all nitrogenous materials in the soil must eventually be converted. In the plant-body, such inorganic salts are "built up" into complex organic compounds known as proteins. These are eaten by the animal and converted in the digestive tract to a soluble form in which they are transferred to the blood. A certain quantity of nitrogenous material, thus assimilated, is retained by the animal for its own bodily welfare, and is eventually oxidized to produce energy. Young growing animals require a comparatively large quantity of nitrogen for the building up of tissues, and such materials are also largely utilized by milch cows for the production of milk. Such of the nitrogen, however, as is not required by the animal—and this amounts to a great proportion in adult beasts other than dairy cows—is excreted by the kidneys in the form of *urea*. Urea in itself is a valuable fertilizer, and has recently been manufactured synthetically ; but when liquid urine is exposed to the air it undergoes a bacterial process known as *Ammonification*.

The organism causing the first stage of this change is named *Micrococcus ureae*, and, if properly controlled, is of immense value to the farmer. *Micrococcus ureae* seizes upon the urea dissolved in urine, and, by the addition of two molecules of water, converts it to ammonium carbonate. The chemical equation representing this reaction may be written as follows :—

$$\underset{\text{Urea}}{CO(NH_2)_2} + \underset{\text{Water}}{2H_2O} = \underset{\text{Ammonium carbonate.}}{(NH_4)_2CO_3}$$

This action is very rapid, and beneficial provided that no immediate further change takes place. Unfortunately, the ammonium carbonate is liable to decomposition if facilities are provided for evaporation

Nature's Fertilizer.

By John B. Hyatt, B.Sc. (Agric.) Lond.

Manure may not be romantic, but it is essential. The farmer considers it one of the most important things in his scheme of economy; the gardener values it no less. This article explains how the plant makes use of it.

As far back as we are able to trace records of the human race, tillage of the land has been the basal industry upon which the life of Man has depended. It is wellnigh impossible to assign a period to Man's discovery of the importance of farmyard manure in husbandry, yet it is probable that many ages before he began to control the destination of animal excreta, and to learn their value as a food for crops, Nature had been effecting exactly the same results on virgin lands. The waste-products of the animal world, dropped promiscuously, formed a link in the cycle of biological nutrition, and established the dependence of plants upon animals as inevitably as animals rely upon plants for their existence.

What it Does.

The practical farmer—probably prehistoric, and certainly historic—relied upon the manure-heap for the encouragement of his crops. He did not know why it was beneficial, nor did he trouble to inquire. At the present day many farmers realise the fact that farmyard manure is a plant-food, and are content to leave the matter at that; yet, with the advance of biology and of chemistry, we now know much more of the "why and wherefore" of plant-nutrition than we did, say, 100 years ago.

The function of farmyard manure is twofold. Firstly, it supplies food to the plant, and, secondly, it acts mechanically, making the soil looser and of a more suitable texture for plant-growth. As a food, it must be studied *chemically*, and may be traced through its various phases from the time it leaves the ground as plant-substance to the time when it is returned to the soil as manure.

The soil is a storehouse for plant-food, containing most of the chemical elements which are essential to growth. Some of these—such as potash—may reside in the mineral substances of which the soil is composed; others, like nitrogen, are present in the form of decaying fragments of vegetation. All these materials, however, in their natural form, are not readily available for use by the plant. Before a nutrient can pass into the root from the soil it must exist in a soluble form; and, while fresh quantities of food are year by year being slowly converted to such a state by the action of micro-organisms, the supply is not equal to the demand. This is especially the case where crops—as in agricultural practice—have to be bodily removed season after season.

We now touch upon farmyard manure as a compensating factor. In the long run, crops feed largely upon their own substance. When the elaborate constituents of plants are passed through the body of an animal, the insoluble compounds of which they chiefly consist are in a great measure rendered simpler and more "available" by the physiological processes of the animal to which they are fed. Looking at the matter very broadly, we may argue that if a substance has been capable of digestion into the blood of an animal, it will subsequently almost as easily pass into the root of a plant. The vegetable food which enters the digestive tract is subjected to the action of digestive juices, and is segregated into two portions. The *indigestible* fraction is that upon which the juices have been able to make no impression, and this part passes chemically unchanged to the exterior. The *digestible* portion is of direct use to the animal. Digestive juices can convert it to a "soluble" form in which it is capable of diffusing through the walls of the digestive tract, and of being absorbed into the blood. Such of its constituents as are little needed by most adult animals, but which form the mainstay of plant-nutrition from the soil, are excreted in the form of urine. It should therefore be obvious that those nutrients which are contained in the liquid portion of farmyard manure are the most available for use by the plant, because they are soluble. The liquid portion is therefore the more valuable.

Economy.

This being the case, it becomes a matter of the first importance to conserve as much as possible of the liquid under conditions which shall provide the minimum of opportunities for certain losses to occur, upon which we shall touch later. The farmer provides "litter" for his beasts, in the form of straw. Straw is capable of absorbing from two to three times its own weight of liquid, and, not only does it *hold* such liquid, but it largely affords protection from evaporation, besides rendering the manure more portable. That portion of farmyard manure which is composed of straw together with solid excreta is concerned

and rise in temperature. In such a case as this, free ammonia gas, carbon dioxide, and water are produced, the valuable nitrogen contained in the ammonia is lost, and the manure deteriorates in worth.

In the soil, however, a different state of affairs obtains. When farmyard manure is applied to a field, the ammonia present in the ammonium carbonate is rapidly converted (also by bacteria) into nitric acid. The latter combines with chalk or lime in the soil to form calcium nitrate, in which state the nitrogen is again capable of assimilation by the plant.

It will readily be appreciated that the formation of free ammonia gas in the manure-heap results in a serious financial loss to the farmer. If the straw-content of farmyard manure is too scanty, a greater

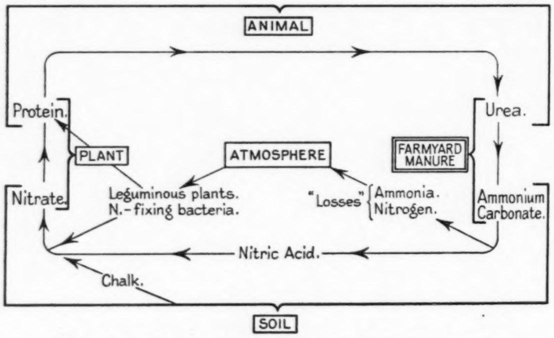

FIG. 2.— ABRIDGED DIAGRAM OF THE NITROGEN CYCLE.

Nitrogen—the most important plant-food which is absorbed from the soil—is continually obeying a cycle of changes from simple to complex forms, and back again. The plant makes it complex, the animal partially breaks it down; in farmyard manure it is further simplified, while soil-organisms, chalk and root acids finally prepare it for re-assimilation by the crop.

Nitrogen "lost" from the manure-heap is added to the atmosphere. This may again be "fixed" by bacteria living in the root-nodules of leguminous plants, such as the pea or bean. The latter build it up into protein within their bodies, and are powerful agents for enriching the soil with nitrogen.

Alternatively, certain *free* bacteria (i.e., not associated with leguminous plants) are capable of "fixing" atmospheric nitrogen in the soil, thus rendering it available to the plant.

surface of urine will be exposed to evaporation, and if the temperature is allowed to rise unduly, decomposition of the ammonium carbonate follows. In both cases nitrogen is lost. The more disturbance and stirring to which manure is subjected, the graver becomes the possibility of excessive loss. A certain amount of decomposition is unavoidable, but, when farmyard manure is frequently carted, or the heap stirred up, losses may reach a figure so great as 40 or 50 per cent.

It follows that the making of farmyard manure, to the best advantage, is no haphazard matter. It has long been appreciated by farmers that litter and excreta should be allowed to accumulate under the animals, fresh straw being supplied periodically. The trampling and consolidation to which the whole mass is subjected minimise the losses above mentioned.

Many other bio-chemical processes enter into the manufacture and possible waste of farmyard manure, but we can only further mention the most important of these—namely, the action of those bacteria which reduce the straw and solid excreta to a substance known as *humus*.

This transformation is the fate, along with straw, of those food-constituents which have not been capable of digestion, and have passed through the animal practically unchanged. During the bacterial process of *humification* a considerable loss in weight occurs, due to the evolution of gases such as hydrogen, marsh-gas, carbon dioxide, water-vapour, and similar simple decomposition-products of carbohydrate material.

Drainage.

Although humus is in itself a store of slowly-available plant-food, its more immediate use in the soil is concerned with the improvement of "tilth." The "pores" of a soil are opened, drainage is rendered more complete on a wet field, and the capacity of holding water is given to sandy land which may normally suffer from drought. In addition to this, the incorporation of humus in the soil promotes aeration—and without air plant-roots cannot thrive.

Much more might be said of the chemical and physical value of this important substance; but, beyond mentioning its worth, it is impossible to devote further space to it here.

THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE.

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Contributions may be sent to Mr. Algernon E. Aspinall, C.M.G., Secretary, 14 Trinity Square, E.C.3, or to the bankers of the fund, The Colonial Bank, 29 Gracechurch Street, E.C.3.

The Argentine Ant.

(*Iridomyrmex humilis,* Mayr.)

By S. Stuart Light, A.R.C.S., D.I.C., F.E.S., and F. G. Sarel Whitfield, F.E.S.

The Argentine Ant is an insect which is actually menacing the supremacy of man. It is spreading and may develop into an extremely serious pest.

READERS of H. G. Wells will recall that in one of his short stories, giving full play to his wonderful imagination, he allows us a peep into future horrors, and tells us how an army of ants deliberately conspires to exterminate the race of man. The extent to which they succeed provides the thrill of the story, though few of us who have read it can have regarded it as more than the merest fantasy. Yet once more has this great prophet of the seemingly fantastic shown that truth is at least as strange as fiction, for in the person of the Argentine Ant there seems some reason for fear that his words may find an actual foundation in fact. This ant has now become one of the foremost pests of man, and bids fair to-day, in some parts of the world, to menace the very supremacy over living things which man has held for some 500,000 years. Dramatic to absurdity though this statement may sound, it is well within the bounds of possibility, as the facts contained in this article will demonstrate.

The Argentine Ant, as its name implies, is a native of the Argentine, and was first described from there by Dr. Mayr in 1866, from specimens taken near Buenos Ayres; for a long time it had been known to occur also in Brazil at San Paulo and Rio Grande do Sal, and in Uruguay at Montevideo and Mercedes. In none of these regions does it occur as a pest, because some factor or other, possibly predaceous or parasitic enemies, helps to keep it under control.

Now in Europe.

From its native haunts the ant has spread far and wide in an almost inconceivable manner. It was introduced with disastrous results into Madeira in either 1886 or 1887, apparently from British Guiana. The United States next reported it at New Orleans in 1891, whither it probably arrived in packing-cases of coffee from Brazil. It was first discovered in Europe about 1902, in Italy, where it is now present at Rome and San Remo, though it was little in evidence till after the war. By 1907 it had spread on the one hand into California, and on the other to Portugal, where it appeared at Lisbon and Oporto, and very soon became dominant. South Africa was next visited by the ant, which was discovered in 1908 at Cape Town, where it appeared to be well established. In 1910 it was reported in large numbers from Chili. Though it was not actually discovered in Germany till 1916, when it was found to be established in hot-houses at Breslau, specimens had been taken in 1911 in the packings of roses exported from Germany to the United States at New Jersey. On several occasions it has been intercepted on plants being imported into Hawaii, especially from California. It is now present in the South of France, having been recorded from Toulon and Cannes in 1920; in the British Isles it is reported from Dublin and Eastbourne. Up to the present, however, the most severe outbreaks have been in Madeira and in the Southern United States. In the latter cases it has spread into many of the more important cotton states, notably Louisiana, Texas, Arkansas, Mississippi, Alabama, Tennessee, Georgia and North and South Carolina.

Identification.

From the above list it will be seen how tremendous has been the extent to which the ant has spread from its native land, how rapidly it has extended and what widely different climates it is able to endure. Luckily it is not a leading pest in every country from which it is reported, but once firmly established it soon begins to give trouble.

The rapidity with which a colony of the ants migrates is truly astonishing. Columns from the main nest are sent out in all directions and at intervals a queen or two will settle down to form a new colony, which in an incredibly short time is also sending out colonising trails. Thus from a single centre a large area may be rapidly infected.

The ants are quite small—smaller than our common British species, their length being only 2-3 mms. in the case of the workers and from 4.5-5 mms. in the case of the queens. They are uniformly coloured deep brown, nearly black, uniform in size, with no distinction as to caste, and they are so similar to several species of other genera that it is extremely difficult to make positive identification unless one should happen to be a myrmicologist; actually, the habits of the adults are the most useful distinguishing character. This character of mimicry affords them valuable protection, rendering attempts at

extermination far more difficult than they would otherwise be.

Throughout the social life of these ants it will be noticed that everything tends to their own increase and to man's discomfiture.

Peaceful Penetration.

The queens do not always remain within the nest, but frequently migrate to form fresh colonies; several may be found in each of the summer nests and hundreds in the winter nests. They will lay, on the average, about thirty eggs per day in the active season, but egg-laying may cease entirely when the mean daily temperature falls below 68°F.

A very important point in the organization of the colonies as a whole is that there does not appear to be any antagonism between separate colonies of the species. To illustrate the significance of this there may be recalled the paragraphs which appeared in the daily papers a few months ago, headed "The Battle of the Ants," giving a graphic account of the warfare which took place in the Insect House at the London Zoological Gardens between two adjacent nests of *Formica rufa*, the common British Wood Ant. The two nests were placed side by side, with a little bridge connecting them over a water division, and though they both contained ants of precisely the same species, the most bitter and sanguinary war was waged between the two communities, till at length one gained the upper hand by the almost complete extermination of the other, the remaining ants of the defeated colony being enslaved by their victors. Now this antagonism between colonies of the same species is the rule with the great majority of ants, and tends largely to keep them under control; it can easily be imagined, therefore, how important a factor is the absence of this ill-feeling in the increase of the Argentine Ant.

In foraging for food the ants proceed in very definite trails, the unfed ants hurrying in one direction, and the fully-fed ones returning along the same path back to the nest. They rapidly detect the presence of food and will immediately form a trail to it. Human food of any kind, cooked or raw, is usually most acceptable to them, though they show a marked preference for certain things, such as sugar, honey, syrup, jams, cakes, pies, fruit, sweets and meat of every description. In their search for provender even refrigerators and ice-boxes are raided, the low temperature apparently having not the least deterrent effect upon them. They are extremely active and have not the slightest difficulty in penetrating into the remotest corners of the house, and the most inaccessible store-places are not safe from them.

ARGENTINE ANTS SWARMING OVER A TEA-TABLE.

It Eats Babies.

It is a common occurrence for these little pests to find their way into bedrooms, where they cause considerable annoyance and inconvenience, for although they cannot sting they are capable of inflicting an extremely painful bite. Unfortunately for us a yet graver aspect of the case has arisen, for the ants do not merely use their jaws in self-defence—they actually feed on living flesh, and numerous cases have been reported of babies which have been attacked in the

cradle; where rescue has come too late the mutilation inflicted has been so terrible that even death has resulted. Many of these reports have been confirmed, and there is no doubt that in certain South American states numerous tiresome precautions have to be taken to ensure the safety of babies and small children.

Their Low Friends.

The repeated attacks of these insects become so intolerable that people are frequently driven from their homes, which are rendered absolutely untenable by the swarms of ants; as a natural result realty values drop considerably. Economically, a yet more serious side of the depredations of these ants is in the field, where they protect and nurture various aphides, mealy bugs and scale insects, and by so doing enable the latter to cause an enormous amount of damage to crops in general. The care which the ants exercise in protecting their protégés is truly amazing; they shelter them from the attacks of their natural enemies, driving off and destroying such beneficial insects as ladybird beetles, and even go to the length of building little shelters over the scale insects as a protection from both enemies and bad weather. The natural result is that the aphides and scale insects flourish to a degree that would be otherwise absolutely impossible. The protection which they afford to aphides makes certain vegetables extremely unpleasant to handle, while cabbage-heads are often found throughout which plant-lice, attended by their keepers the ants, are so thickly distributed that the leaves appear to form merely divisions between layers of the insects.

In addition to the damage they cause thus indirectly, the ants are a source of extreme annoyance to growers of vegetables or truck-crops in Southern U.S.A., by direct attack on the living plants, particularly in the removal of seeds before germination, lettuce especially suffering in this way. In florists' shops the ants sometimes sever the petals of choice blooms in their efforts to reach the nectar, and in visiting flowers of all kinds, which seems to be a natural habit, if they do not find the nectar readily, they invariably cut their way to it, where the plant tissue is tender enough to permit of this. Their ravages on orange blossoms are especially severe, for they frequently bore into the fruit-buds before the latter are fully open. So great are their depredations in the orange-groves of Southern Louisiana that the value of the land in that section has come to depend, to a large extent, on the presence or absence of the Argentine Ant. Considerable loss is also caused to the fig crop by the insects boring into the ripened fruit, or entering the calyx-end, and tunnelling out the interior; they also assist very greatly in the increase of the Fig Mealy Bug (*Pseudococcus citri*).

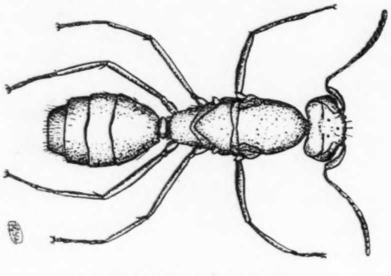
Among honey-bees their attacks are so deadly that bee-keeping on any large scale is nearly always abandoned when the ants have become numerous. It is even a pest to be reckoned with in the poultry-yard, where the nests of sitting-hens prove especially attractive. Woe betide the hen if by some chance an egg be broken in her nest! The blood and fluid from partially incubated embryos form a great attraction to the ants, which will swarm there in such hordes that the hen is usually compelled to abandon her nest. When hatching-time arrives, the emerging chicks are set upon by large numbers of ants, so that death frequently ensues. The nests of many birds are attacked in this manner, and the mortality amongst the young must be considerable. The English sparrow alone seems to be able to treat the ant with contempt, and flourishes, as ever, in spite of them.

So far, in dealing with the relations of the Argentine Ant with other insects, we have only mentioned cases of friendship and protection; actually, however, the ant is antagonistic to the great majority of insects, including, as far as is known, all other species of ants, with the exception of *Monomorium minimum*, colonies of which have several times been found in close proximity to those of *Iridomyrmex humilis*, and apparently on the best of terms. The result of this antagonism is that such beneficial species as the Fire Ant (*Solenopsis geminata*), which destroys a considerable number of Cotton Boll Weevils in their immature stages, are exterminated; on the other hand, another ant, *Eciton schmitti*, is an active raider of the nests of the Argentine Ant, and is consequently extremely beneficial to man. The Argentine Ant itself was thought at one time to attack the Boll Weevil; investigation has proved, however, that far from doing this, they merely harass the weevils, with the effect of driving them elsewhere, and thus helping to broadcast them!

Their Dirty Habits.

Finally, as a cap to this long list of crimes, comes the suspicion that the Argentine Ant is a carrier of disease; for the workers have been observed to congregate in large numbers around garbage-heaps, refuse-pails, latrines, etc.; moreover, they are extremely difficult to keep out of sickrooms, the various odours emanating therefrom seeming to attract them, and they have actually been watched busily carrying away the sputum of a negro suffering from tuberculosis! Thus it will be seen that there are many sources from which they may obtain the germs of disease.

Against this evergrowing list of annoyances to man, the Argentine Ant can bring forward but two definitely good deeds, namely the destruction, in large numbers, of the Sorghum Midge (*Contarinia sorghicola*, Coq.)—it is, in fact, the chief means by which the midge is



ARGENTINE ANT: QUEEN.
(From W. Newell, *U.S. Dept. Agric. Bulletin*).

controlled in southern Louisiana—and the raiding of the nests of Termites or White Ants, which are frequently driven out and destroyed, and their nests occupied by the raiders.

The chief sufferers, personally, are the inhabitants of the towns in infected areas, where the ants swarm over everything—clothes, food and all! But financially it is the bee-keepers, the poultry-farmers, orange-growers and other agriculturists who suffer most. This completes, in a somewhat sketchy fashion, the ravages of the ant in the U.S.A.

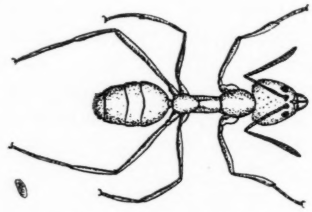
Devastated Island.

Dr. M. C. Grabham, in an account of the depredations of the Argentine Ant in Madeira at the 1919 meeting of the British Association at Bournemouth, describes how it spread throughout the island up to 2,500 feet above sea-level. Coffee cultivation has been ruined, citrus has been almost entirely destroyed, bananas and sugar cane are badly affected and sweet potatoes have disappeared from many districts; bees, young birds, and poultry, naturally defenceless against the ant, are being rapidly destroyed. In discussing the food-securing habits of the ant, he describes how they will construct bridges in order to reach flies caught on sticky papers, and an illustration of their numbers is found in the fact that 40,500 specimens were taken on one lime tree. The only enemies of importance there appear to be spiders, one specimen of which, *Pholcus phalangoides,* is especially formidable in this respect.

The only conditions which seem to affect the ant adversely are floods and excessive rainfall, and in flood-time thousands of dead ants have been seen in ditches and on roadsides; but such is the mobile capacity of the ant that the majority of them manage to escape on such occasions to higher ground. Even when actually caught in a flood they often win through by forming themselves into balls, with the larvae inside and the queens and workers on the outside. These balls may be from two to six inches in diameter, and float readily; they are kept turning over continually by the outermost workers always climbing to the top of the ball in order to get free from the water, thus enabling the larvae in the centre to obtain sufficient supplies of air.

Intelligent Staff Work.

Coupled with their extreme ferocity and excellent fighting qualities, their extraordinarily rapid rate of progress renders them formidable enemies to all who are antagonistic to them; and in the case of Man they even make use of his inventions of travel for their own conveyance, one of the chief factors in their remarkable distribution being railways! They cross the oceans in Man's ships, and many countries have been entered by this means, the little stowaways lying concealed in plants, packing-cases and other goods. The only checks to their claiming the entire world as their hunting-ground are the extremes of climate and certain other conditions such as natural enemies. The latter appear to be but few in number, those so far recorded comprising merely a species of cockroach and certain spiders, and the Flicker, or Yellow-hammer, among birds, which has often been seen industriously scratching up their nests, and greedily devouring the ants thus disclosed. None of these, however, destroy the ants in sufficient quantities to lessen their numbers to any appreciable extent. Even parasites appear to be unable to cope with this amazing insect; numerous experiments



ARGENTINE ANT: WORKER.
(From W. Newell, *U.S. Dept. Agric. Bulletin*).

which were tried with *Pediculoides ventricosus,* a mite parasitic on the grubs of wasps, resulted in failure, for the ferocity with which the mites were greeted, on being introduced into the ants' nest, invariably proved too much for them. No more successful were attempts at infecting the nests with fungous diseases, for in each case the fungus failed to make any headway.

Mention has been made earlier of a factor which keeps the ant under control in its native land, the Argentine; the exact nature of this factor, whether insects, spiders or birds, plant or animal parasites, we have been so far unable to ascertain, and the discovery of this is one of the main objects of scientists who are fighting this international pest. So far, however, as has already been pointed out, the only barrier has been found to be climatic conditions, and it will be safe to assume that the Argentine Ant is unable to persist beyond the minimum isotherm of zero.

Poison Warfare.

If one is unable to exterminate this insect, one can at least repel it as far as possible, and when houses are raided this is, of course, an essential measure in self-defence. To prevent the ants from swarming over everything, various repellents are extensively used. Water is only effective for the short period before a film of dust settles on it, forming a bridge for the ants, so that standing the legs of furniture in basins of this fluid is next to useless. Paraffin, though quite successful, can, by reason of its unpleasant nature, only be used out of doors. Thus for prevention inside the house the best method is that of banding the furniture and shelves with strips of tape treated with various substances, of which perhaps the most effective is corrosive sublimate. The tape is soaked in a solution of sublimate, and then wrung out and dried; these bands have been known to retain their effect for over four months. In the banding of trees, the ordinary sticky "tanglefoot," diluted down, may keep the ants away for as long as a fortnight; bands of fur, as advised against some ants, are quite useless for this purpose. Poisoned baits form the best method of actual destruction of the pest, many different mixtures having been devised. The most generally accepted is one modified from Barber's original formula, and consists of the following ingredients:—

Water	11 pts.
Sugar (granulated)	12 lb.
Honey (strained)	2 lb.
Tartaric acid (crystallized) ...	7 gms.
Benzoate of soda	9 gms.
Sodium arsenite (pure)	21 gms.

The method of preparation is somewhat complicated, and need not be gone into here—it is sufficient to say that a syrup is evolved which is put into either paper bags or small tins provided with lids. In both cases the receptacle is made watertight by immersion in melted paraffin wax, and small holes are bored in the sides, large enough to allow the ant to enter, but sufficienty small to keep out the honey-bee. The bags or tins are then nailed on to trees or fixed in other similar situations, and inspected monthly.

Another means of extermination is, of course, the fumigation of the nests, though this is only possible where the latter are of small area and possess but a few entrances; in many cases the nests are of enormous dimensions, extending underground over a very large area, and are provided with many exits, so that the fumes, when injected, readily escape without causing much damage to the nest. The best fumigant is carbon bisulphide, though potassium cyanide is also very effective; hydrocyanic acid gas, however, should not be used.

Yet, when all is said, the control which is effected by the use of poisons, banding and fumigation is but slight in destruction of the workers, which compose the vast majority of the ant community, and does not affect the reproduction of the race, which is carried on by the queens alone, unless the latter be exterminated with the workers.

Climate Helps.

Now let us review the problem which presents itself to the world's entomologists. We have seen that the Argentine Ant does an enormous degree of damage, both direct and indirect, that it spreads with extraordinary rapidity, that great difficulty is experienced in controlling it and that no natural enemies have so far been found which will keep it in check outside its native land. Climate alone imposes a limit to its universal migration, and this fact proves the salvation of the more temperate lands. The colony at Eastbourne shows no signs of increasing, but seems to be just able to hold its own against the vicissitudes of our English winters. A method practised successfully in the past in the case of serious pests such as the Mauritius Beetle is the discovery and introduction into the infested countries of a parasite capable of controlling or exterminating the pest. In all probability the solution to the problem here does not lie in this direction; the social nature of the ant, for one thing, renders this improbable. The answer to the question will only be found by a more minute investigation into the habits of the ant in various countries, resulting in the possible discovery of a hitherto unknown method of control.

What We Owe to Huxley.

By Prof. J. Arthur Thomson, M.A., LL.D.

This month we celebrate the centenary of Thomas Henry Huxley. Few men have had greater influence on scientific thought or did more to free science from the tyranny of dogma. He is one of the greatest figures of his age.

CHARLES DARWIN was a great originator, for, although the general idea of evolution is ancient, he gave it an acceptable concrete dress. After allowing for evolutionists before Darwin and for the philosophically evolutionist mind of Spencer, we must recognize that Darwin made the modal formula of evolution current intellectual coin. It was the "Beagle" voyage, like Columbus's, that discovered a new world—an evolving world. As regards the theory of natural selection—Nature's sifting in the course of the struggle for existence—and as regards sexual selection, Darwin was also an originator, and, as regards the first, the magnanimous Wallace was his independently originative colleague. But even the most enthusiastic admirers of Thomas Henry Huxley would not rank him as an originator in the field of evolutionism. He was original in other fields, but not in that which he himself called ætiology. But here he was the champion—strong in defence, fearless in attack, a "braw fighter." He was a cutting edge, a propagandist; and the victory of the evolutionist way of thinking would have been slower if it had not been for Huxley.

A Warrior.

No doubt there were others who aided and abetted in spreading "the new and pernicious doctrine," such as the cautious Lyell in this country and the impetuous Haeckel in Germany, but we owe it especially to Huxley that the idea of evolutionism was driven home with convincing force. He discovered new lines of so-called evidence; he trotted out the evolving horse—a veritable *cheval de bataille*; he illustrated the evolution-idea from his wealth of anatomical and embryological knowledge; he routed the armies of the critics. This was his first great service.

From the fauna and flora Darwin carried on the evolution-idea to the ascent of man. Spencer continued the projection into psychology and ethics, and Huxley was another *continuator.* He saw with vividness that the evolution-idea must leaven the whole lump, and with his lucid style he did much to bring the intellectual combatants of his generation to look at everything *sub specie evolutionis*—to make the transition from a static to a kinetic (or a genetic) outlook. The evolutionist picture includes not only the emergence of man as an organism, but his continued ascent as a social person, with a gradually enriched external heritage. We must link "Man's Place in Nature" (1863) to the Romanes lecture on "Evolution and Ethics" (1894), to see how the idea of evolving man deepened in Huxley's mind, and deepening became more intense—almost passionate in the conviction that in the study of organic evolution along with human history there is to be found secure guidance for the advancement of the race.

Ethical Interpretation.

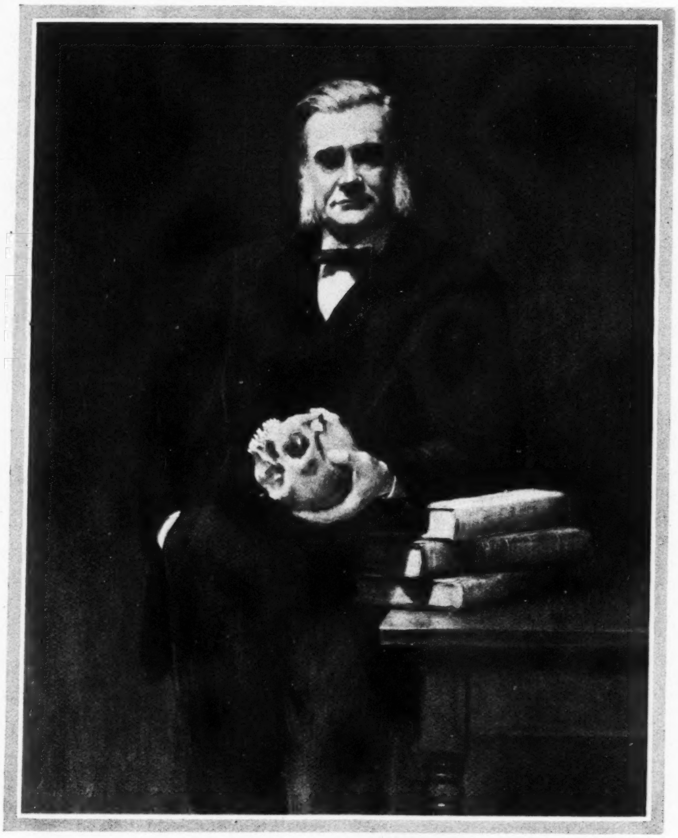
While the Romanes lecture lays emphasis on man's apartness—as a moral agent—from animate nature, which seemed to Huxley frankly amoral, and counsels man in his ethical endeavours to set his face rather towards Jerusalem than in the line of Nature's struggle for existence, it must be remembered that Huxley was one of the foremost in exposing the fallacy of regarding man as a passing traveller through a foreign cosmos. To him it was always clear that man is solidary with the rest of creation; the main point of the Romanes lecture was that man must *transcend* Nature's regime. Its weakness, we think, was in failing to recognize how strongly Nature is on man's side—especially when he is at his best.

In his recently published "Impressions of Great Naturalists," which includes very interesting reminiscences of Huxley, Professor Henry Fairfield Osborn speaks of Darwin as the great emancipator, inasmuch as he set men's minds free from authority and dogma to inquire for themselves into the truth. He goes the length of saying that this was more important than the Darwinian theory of man as emerging from a primate stock which also gave origin to the anthropoid apes. We must quote from memory, but Osborn goes on to express his opinion that man would have been just as happy and moral if he had continued to believe that he was created in the image of God. Coming from such a distinguished evolutionist as Osborn, this is a very interesting view; but we do not think that it would have met with Huxley's entire approbation. No doubt Darwin, born in the same year as Abraham Lincoln, was a great liberator, but there is no single man who can be said to have won

a Magna Charta for man's freedom to think for himself. That has been the outcome of a prolonged struggle in which many took part long before Darwin was born.

An Emancipator.

Perhaps we should not dwell on Professor Osborn's suggestion that man would have been just as happy and moral in a creationist belief, and that therefore the emancipation Darwin brought was more important than his Darwinism. Yet our great admiration for Osborn prompts us to say three things:—(1) that it was the cogency of Darwin's evolutionism that vindicated the validity of free thinking; (2) that if a conclusion is in the direction of the truth, it is quite irrelevant whether it makes us happier or more moral: it is all or nothing with science; we cannot pick and choose, as the American "fundamentalists" would do, as if from a bill of fare, deciding on what we think is most palatable or digestible; (3) moreover, in contrasting a belief in man as the child of God with a knowledge of man as the outcome of an evolution-process naturalistically describable, one is guilty of the fallacy of making a false antithesis between a transcendental interpretation and a scientific description. Of course, Osborn knows all this as well as we do; we mean merely to suggest a change in his phrasing which, as it stands, is apt to mislead the unwary.



THOMAS HENRY HUXLEY.
From the portrait by his son-in-law, the Hon. John Collier, in the National Portrait Gallery.
(Copyright, National Portrait Gallery).

The relevancy of this is that Huxley was one of the great modern emancipators. Convinced of the validity of the evolutionist description of man, he showed how it could be used to illumine the past, the present, and the possible. It was not that he waved the banner of "freedom of thought"; it was that he led men under this banner to victory. What victory? To secure knowledge and understanding which can be used as a basis for action. We doubt if anyone has ever had a greater "passion for veracity," a greater reverence for the facts. The conclusion, he said, that outstrips the evidence, is not only a mistake, it is a crime. It is not crying "free thought" that liberates, it is the truth that makes us free.

Facts.

There is need today to learn from Huxley the lesson of building on facts. The precision of workmanship that marked his anatomical analysis was characteristic of all his thinking—always firm without loose ends, always clear without vagueness. He liked Bacon's aphorism: truth sooner to emerge from error than from confusion. "Next to being right in this world," he said, "the best of all things is to be clearly and definitely wrong, because you will come out somewhere. If you go buzzing about between right and wrong, vibrating and fluctuating, you come out nowhere; but if you are absolutely and thoroughly and persistently wrong, you must, some of these days, have the extreme good fortune of knocking your head against a fact, and that sets you all straight again."

Freedom of thinking is apt to become licence in thinking, and thus we get theories about evolution

by authors who have not read their Darwin, theories about the body by authors who have not even consulted Huxley's Physiology with its wonderful carefulness, theories about the earth by authors who have not understood Lyell. There is need to go back to Huxley to learn from his work a deeper reverence for facts. We think that it was one of his services that he helped to emancipate large domains of thought from the tyranny of authority; but let us be clear that he did so by demonstrating that scientific method is a sure guide so far as it goes. It was fact-thinking, not free-thinking, that he championed. It was this dominant mood of scientific caution, we think, that kept him from saying more about the factors of organic evolution. He felt that the data were inadequate. How cautious he was in his statements on such a question as the origin of the living from the not-living. Though he never made any secret of the trend of his thinking, he counselled "agnosticism." Let us be franker, he advised, in saying "We do not know." But let it be an active agnosticism—a *thätige Skepsis*—a search for more facts. We may say *Ignoramus*; we dare not say *Ignorabimus*. Thus in ranking Huxley among the emancipators, we have ventured to emphasize the contrast which he so well illustrated between liberty and licence.

It is very interesting to notice how much the Darwinian evolutionists thought of the application of their doctrines to the problems of human life. "Science for life," said Spencer, "not life for science"; and he was true to this with what energy he had. Alfred Russel Wallace was passionately interested in social problems; he was always asking, with the grand seriousness of his generous nature, How does this science contribute to the relief of man's estate? Similarly with Francis Galton, whose whole life after the publication of his cousin's "Origin of Species" (1859) was thrilled by the idea of understanding the laws of evolution and heredity in order to help towards the betterment of the human race.

This ideal of science for life was the keynote of much of Huxley's life. Indeed, he sought after new knowledge for its own sake, but even stronger than this intellectual motive was the endeavour to contribute to the well-being of mankind. Hence his efforts towards scientific education, hence his untiring popularisation of science, hence his "endless series of battles and skirmishes over evolution." *Savoir pour prevoir, et prevoir pour pourvoir.*

As Huxley himself once said, he had an *engineer's* interest in animals; he liked to discover how they were constructed and how their parts worked.

He was one of the first-class intellects of his day and generation, and the question rises: What were his great discoveries? The answer must be, we think, that Huxley's genius found expression primarily in more or less technical generalizations such as the grouping of Vertebrates as Ichthyopsida, Sauropsida, and Mammalia—a great step; or his clearing up of molluscan structure, which Sir Ray Lankester continued; or his clarifying comparison of the two layers of a hydroid polyp (ectoderm and endoderm) with the two layers of a diploblastic embryo (epiblast and hypoblast); or his puncturing of the misleading vertebral theory of the skull; or his classification of birds; or his grouping of mammals in three grades. It is in considering such advances that we appreciate the firmness of Huxley's grip and his penetrating insight. Of course, it must be remembered that comparatively early in his life Huxley became involved in the tasks of administration and organization and education, and that he was necessarily appealed to for help in connexion with fisheries and similar practical problems. The marvel is that he did so much.

But there was another line of activity in which Huxley's originality showed itself in a manner approaching discovery. He was able to vitalize the facts and concepts of biology in a unique way. It meant vividness in visualizing, picturesque imagination, a feeling for words, the instinct of the teacher and, we must not forget, a willingness to take trouble—to be clear. If we ask ourselves what we owe to Huxley must we not add to what we have already tried to recognize, that he had a masterly gift of vital exposition. He was able to make others share his visions.

How can we end better than by quoting Huxley's own account of the objects to which he had consciously devoted himself. These were:—

"To promote the increase of natural knowledge and to forward the application of scientific methods of investigation to all the problems of life to the best of my ability, in the conviction which has grown with my growth and strengthened with my strength, that there is no alleviation for the sufferings of mankind except veracity of thought and of action, and the resolute facing of the world as it is when the garment of make-believe by which pious hands have hidden its uglier features is stripped off."

SMALL quantities of radium have now been definitely isolated from meteorites. A giant meteorite in Colorado is about to be commercially exploited for its platinum content. The price of platinum to-day is £25 an ounce. The associated metal Palladium costs £19 10s. per ounce.

Restorations of Extinct Reptiles.

Drawings by Miss Alice Woodward
(of the British Museum, Natural History).

Some of these extraordinary prehistoric beasts roamed over England. Their bones are found in the chalks and clays. Science, reclothing them, gives us a picture of the animals as they were in the flesh.

How little we know about the excellent work done by our museums. It is a dark secret, but between you and me and the Easter Island statues outside the British Museum, the most wonderful and the cheapest postcards in the world are to be bought both at the British Museum in Bloomsbury and at the Natural History Museum, South Kensington. The trouble is that any amount of people who would appreciate these cards do not know that they exist.

I knew that there were postcards of sorts on a stall at the entrance, but until a review packet of prehistoric beasts, a new issue, and a list of existing material landed on the editorial blotter, I had no idea of the resources of South Kensington. There are cards of every available animal, from the aye-aye to the walrus. There are cards of British and alien dogs—named champions all of them, British birds, birds' eggs, representative British insects, foreign, exotic and noxious insects, British butterflies, moths, flowering plants, fossil man, fishes, plants and mammals; sponges, corals, frogs and toads, the life-history of the common eel, meteorites and all sorts of things.

Their Settings.

These cards are not only the usual casual "souvenirs"; they possess a direct educational value as a basis for nature lessons or as a guide to collectors, and also, as can be seen from the reproductions accompanying this article, they are astonishingly good work as pictures in themselves. It is not a trivial accomplishment to be able to conjure these fossil bones to life and clothe them with scaled hide and gross muscle so that they live, yet Miss Alice B. Woodward has succeeded in conveying not only a picture of the reptiles but a queer sense of vitality and movement against a true background.

The long-necked Cetiosaurus browsing beneath the water on the waving kelp; that Gothic horror the Pteranodon set in flight like a string of wild duck across a Japanese moon—these give a picture that carries in itself a better and clearer conception of the animal and its environment than can be gathered from even the best "reconstruction." And most of these beasts lived in England once. Their bones are found in the Oxford clay.

The purpose of this article is to draw attention to some of these postcards and the accompanying leaflet, which gives in compressed form the essentials about each beast. This particular set happen to be prehistoric reptiles, but it should not be forgotten that British butterflies, moths and birds' eggs (a form of collection that we do not particularly encourage) are also available, and that a discount is allowed to educational authorities buying cards in quantity.

In the Secondary or Mesozoic Era, during which our Lias clays, our Oolites, and our chalk were among the rocks laid down in the sea, the reptiles were so dominant in numbers and in size of individuals, that this portion of geological time has been called the Age of Reptiles. They swam in seas and rivers, crawled and ran and leaped on land, climbed rocks and trees, glided and flew in the air. For the most part we know only their skeletons, which have been preserved as fossils, but are not always complete; remains of the smooth, scaly, or armour-plated skin are rarely found. Enough, however, is known to justify the claim that these restorations, drawn by Miss Alice B. Woodward, under the direction of the late Dr. C. W. Andrews, Professor D. M. S. Watson, and the Officers of the Geological Department, are not far from the truth. The specimens on which they are based are exhibited in the Gallery of Fossil Reptiles in the Department of Geology. Reconstructions of *Iguanodon* and *Triceratops* are in the Reptile Gallery of the Department of Zoology.

G. 61. *KANNEMEYERIA.*

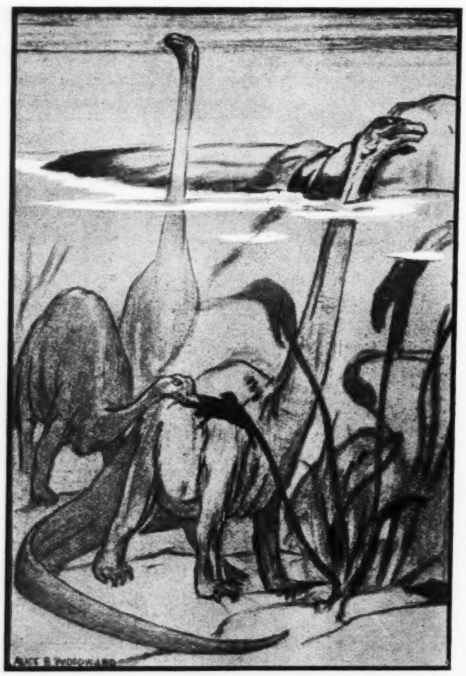
Among the earliest reptiles were several not far removed from amphibians, and yet in some respects related to mammals. Their teeth were of varied character, and in one group there was a pair of tusks, growing throughout life, at the side of the upper jaw, whence the group is called Dicynodontia (double dog-toothed). One of this group was the ungainly creature called *Kannemeyeria* (after the Boer who collected some of the bones). It was about six feet long, with a stumpy tail and an arched back; the length of the head was about one foot. It walked on all-fours, with the upper part of the limbs nearly at right angles to the body, so that the gait must have been exceedingly clumsy. The feet were five-toed and adapted for digging. The turtle-like beak and the nature of the teeth suggest that *Kannemeyeria* was a vegetarian. Perhaps it grubbed up roots in those desert regions of South Africa which it inhabited in Lower Triassic times.

G 64. *METRIORHYNCHUS.*

The extreme adaptation of a crocodile for life in the sea is shown by *Metriorhynchus* (moderate-snout), found in the Upper Jurassic rocks of Europe. The elongated snout, with nostrils at the end of it, was furnished with large teeth flattened on the sides and set in sockets. The back-bone turned down sharply

KANNEMEYERIA.

METRIORHYNCHUS.

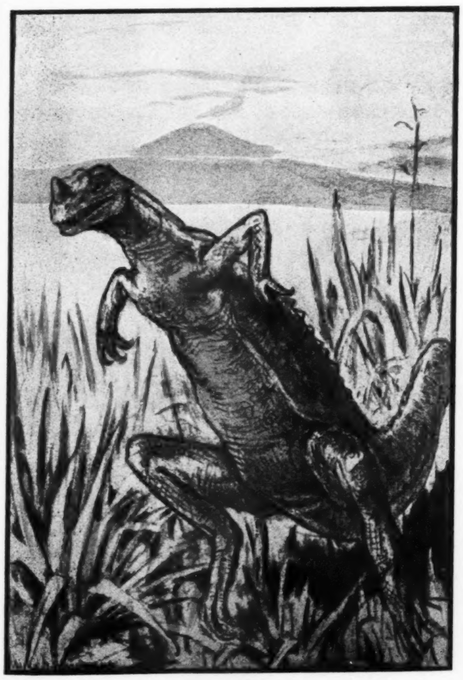


CETIOSAURUS.

POLACANTHUS FOXI.

TRICERATOPS.

IGUANODON.



CERATOSAURUS.

PTERANODON OCCIDENTALIS.

at the tail, as in *Ichthyosaurus*, and doubtless bore a vertical triangular fin. The fore-limbs were small and flipper-like; the hind-limbs were shaped like those of a crocodile, but relatively larger for strong swimming. There were no bony plates in the skin, which must have been smooth, as in a porpoise. Examples of *Metriorhynchus*, and of a crocodile with a longer snout, both from the Oxford clay of Peterborough, are shown in Case D of the Fossil Reptile Gallery.

G 65. *CETIOSAURUS.*

The land reptiles of the Jurassic and Cretaceous epochs are called Dinosaurs ("terrible lizards"). Some of them were unarmoured and walked on all-fours, but their enormous size was often such that they must have been too heavy for a life on land, and it is supposed that they lived in estuaries or in the shallow waters of the seashore, browsing on sea-weeds or vegetation on the banks. The North American *Diplodocus* is one of the largest and best known, but the tallest of all was *Gigantosaurus* or *Tornieria* from Tendaguru in Tanganyika. The British representative is *Cetiosaurus* ("sea-monster lizard") from the Oxford clay. It stood about twelve feet high at the shoulder, was about sixty feet long, and when alive must have weighed about thirty tons. The long neck supported a small head with the nostrils on the top, as in other air-breathers that live under water. The brain was remarkably small; but there was a large nerve-centre in the loins, governing the movements of the hind-limbs and the extraordinary long tail. The teeth were long, cylindrical, and separated, so that the front of the jaws looks like a couple of rakes. Remains of *Cetiosaurus* and allied genera are in the Fossil Reptile Gallery; a plaster restoration of *Diplodocus* is in the Reptile Gallery of the Zoological Department.

G 66. *POLACANTHUS FOXI.*

Living on land and feeding harmlessly on vegetation, certain Dinosaurs acquired a defensive armour of spines, horns and plates, whence they are called Stegosauria ("plated lizards"). One of these is *Polacanthus*, discovered in the Wealden beds of the Isle of Wight by the Rev. William D. Fox in 1865. It was a four-footed creature with a broad body and a long slender tail. On the back and tail there was a paired series of spines, and the hip-region was protected by a continuous body-shield ornamented with symmetrically arranged bosses. The head was comparatively small, and the teeth were feeble. Remains of *Polacanthus* are shown in wall-cases 4 and 5 of the Fossil Reptile Gallery.

G 67. *TRICERATOPS.*

Certain Stegosaurs, which lived in North America and East Asia, bore horns above their eyes, whence they are called Ceratopsidae. *Triceratops*, as its name implies, had three horns, the third being in the middle of the nose. The soft vulnerable neck was further protected by a bony frill stretching back from the large skull. For the rest the skin was covered only with horny scales. In front of the jaws was a horny beak to bite the herbage, which was chewed by the long rows of grinders at the back of the jaws. The tail was long enough to sweep the ground. *Triceratops* was the last of its family; the earliest member is that which laid its eggs in the sands of the Gobi Desert. A cast of the complete skeleton is exhibited in the Reptile Gallery of the Zoological Department, and a skull, with casts of the diminutive brain, is in case P of the Fossil Reptile Gallery.

G 68. *IGUANODON.*

This is an example of the Ornithopoda or "bird-foot" Dinosaurs, which had hind-limbs much like those of an ostrich, with three toes on each foot. On these they walked, using the short fore-limbs with their five-fingered hands for grasping trees on whose leaves they fed. *Iguanodon* had a horny beak, and the lower jaw is extended and hollowed in such a way as to suggest the presence of a long prehensile tongue with which it pulled off the leaves. There are no front teeth, but at the back is an elaborate battery of teeth by which the leaves were crushed. From the resemblance of these teeth to those of the Central American lizard, *Iguana*, Dr. Gideon Mantell gave the name *Iguanodon* in 1825; he had found some teeth at Cuckfield, Sussex, a few years before, and they were among the earliest remains of any Dinosaur to be discovered. The body is balanced by a long tail, which is flattened from side to side as though occasionally used for swimming. Remains from the Lower Cretaceous rocks of England described by Mantell and others are in table-case 17 and wall-cases 6, 6a and 7 of the Fossil Reptile Gallery. The plaster reproduction of a complete skeleton from Belgium is in the Reptile Gallery of the Zoological Department; its height is fourteen feet and its length about twenty-five feet.

G 69. *CERATOSAURUS.*

The herbivorous land Dinosaurs were preyed on by other Dinosaurs called Theropoda ("beast-feet"), of which *Ceratosaurus* ("horn lizard") is an example. It ran on its hind legs, like *Iguanodon*, seizing its prey with its fore-limbs; but the skeleton was much lighter, and the strong jaws were armed with teeth like curved saws. The character of the skin is unknown. *Ceratosaurus* was only ten feet long from nose to tail-tip, but some other Theropods were much larger. Its remains are found in delta deposits of Upper Jurassic age in North America.

G 70. *PTERANODON OCCIDENTALIS.*

This is an example of the Pterodactyls ("wing-fingers")—flying reptiles in which the fifth finger was enormously lengthened to support an extension of the body-skin. Their bones were strong, but made light by air-cavities, as are those of birds; the total weight of a fossil skeleton with a wing-span of fifteen feet may be less than six pounds. Many Pterodactyls had teeth, and fed on insects or smaller Pterodactyls; but *Pteranodon* ("wing-sans-teeth") was toothless, and probably scooped up fishes with its deep beak, shaped like that of a pelican. This species, one of the last and largest, measuring eighteen feet across the wings, fished in the chalk seas of Kansas; fragments of equally large Pterodactyls are found in the English chalk. The flight was probably like that of an albatross, by gliding and soaring on air-currents rather than by flapping. The large crest at the back of the skull balanced the beak, and perhaps counteracted its windage. A restoration of the skeleton is on the east wall of the Fossil Reptile Gallery.

SALT AND URIC ACID.

WE have always been told that it was good to eat salt with our meals. A really acceptable reason has never yet been given, at least a reason that has actual experimental fact behind it. Bio-chemists in America, however, conclude, from their experiments, that it serves the valuable function of reducing the uric acid in the blood, and this is particularly marked in persons on a diet too rich in either proteins or carbohydrates.

A Journey in Inner Mongolia.

By L. H. Dudley Buxton, M.A., F.S.A.

Collecting anthropological data is an interesting job. The author describes incidents of travel and a Mongol wedding ceremony.

I HAPPENED to be in Peking in the spring of 1922 just at the moment when it seemed probable that the city might be the centre of a struggle between two conflicting parties. I did not want particularly to be shut up in the city, and a chance presented itself to go beyond the Great Wall of China into Inner Mongolia. It was a chance not to be missed, and I jumped at it, and, as luck would have it, we left the city by the last train which went north for some days. I wanted principally to see the wonderful country of "the Long Grass" of which I heard so many tales in Peking, and, if opportunity offered, to take photographs of the people and collect any anthropological data that might be available. One of the great advantages of being an anthropologist is that your work is apt to take you to such delightful places, and if the truth be told, it was rather the thought of getting out on to the plains than the prospect of anthropological work that led me to Mongolia.

A Cart Journey.

I had the good fortune to be accompanied by Dr. Stevenson of the Rockefeller Institute in Peking, who spoke Chinese well and whose local knowledge made the expedition possible. We went by train from Peking to Kalgan. This town is the "railhead" for the overland route between China and Mongolia and the lands which lie beyond. It forms the end, as it were, of regular communication with civilization as we know it. Beyond lies first grass steppe and then Gobi, but no railway until Irkutsk is reached. We began our work near Kalgan by investigating some caves in the mountain side beyond the Great Wall, but found nothing except traces of recent habitation. This disappointment was, however, more than compensated for by our journey which began next day. Our first stopping-place was a small town called Sinhwa. There was no room in the inns, so we made friends with a dealer in tobacco and slept on the *kang* in his back shop. A kang is a raised daïs underneath which the heat from the stove is carried. It forms a warm, sometimes a too warm, sleeping-place, but we were lucky to find a bed at all. Our drivers—for we each had a springless covered cart drawn by a mule and a pony harnessed in tandem—slept with the animals.

The next day we started at dawn. At this time of year—it was late April—the plains are very lovely. The sky is blue, with a nip in the air in the morning, and larks fill the air with their song. The plains are covered with a short grass and resemble our downs. The early spring flowers were beginning to appear. The commonest was a little stalkless blue iris, but there were more familiar flowers, some Pasque anemones and a little primrose, like *Primula farinosa* (the mealy primrose) which grows in the north of England. We were now in the true Mongol country. We still kept passing a few scattered Chinese villages, most of them of recent construction. They were all the same. Each house was strongly built of mud and stone. The larger ones had a courtyard in front strongly walled in and guarded by savage Mongol dogs, like overgrown collie pups, who were well described by our driver as "unreasonable"—in other words, best avoided. We slept that night in a little inn. The interior had only one room, with a raised kang on either side. The dust of ages lay thick upon it, but we managed by putting our camp beds on top to pass a reasonably undisturbed night. By allowing our drivers to share our part of the kang we avoided the crowd in the inn who used the other half. Next day we left the trade route which we had followed so far and struck across country to a missionary settlement.

Calliper Treatment.

It so happened that our work in physical anthropology began soon after we reached Hallong Osso, a mission which we were allowed to make our headquarters and, though it continued all the time we were there, it may be described first. The mission had no doctor, and the arrival of Stevenson, and the report that he could heal all manner of diseases, immediately gave us a reputation without which it would have been difficult to do as much work. First the sick who were connected with the mission appeared, and then, as report spread, we had others. This was my opportunity. The majority of the people were not very ill, and we explained that to measure their heads with anthropometric callipers was part of the treatment. So every patient was measured and other observations made and then passed to

Stevenson for medical treatment. I cannot say how far it was the callipers and how far Stevenson's skill, but most of them professed to be very much better after they had passed through our hands. The physique of the Mongols is very interesting. Although we are accustomed to call yellow man Mongolian, it soon became clear that, even here where there has been much Chinese admixture, they were for the most part very different from the Chinese, and belonged indeed rather to a branch of the races which inhabit Europe than to the true "Mongoloid" race. They are all brown in colour, tanned by the winds and sun of the plain, but if a part of the body is examined which is not exposed to the climate it is surprising to see how very white they are. Many have the straight open eye, as we have, although the oblique eye occurs where there has been Chinese admixture. The hands of the Mongols are very different from the Chinese, being much shorter and broader. The head is broader than that of the Chinese, and is often curiously flattened behind, a characteristic which is found among many of the eastern representatives of European races.

Nomad Homes.

Measuring and photographing was carried on at intervals, wherever Stevenson held a clinic or I could find suitable and willing victims; but whenever we could we rode out to see the Mongol villages. They have two kinds of tents, for houses they have none. The first kind is simply a ridge-pole tent which is used for travelling. It is rapidly packed upon a camel and is covered with a blue material. The more permanent kind of tent is known to the Mongols by the name of *yurt*. This is a more elaborate affair and may be called their true home. A yurt is round with upright walls and a sloping roof. It is made in three parts. There is usually, but not always, a low circular foundation of earth and stones. On top of this a kind of framework of lattice, not unlike the wooden trellis-work we use in gardens, is set. This is kept in position with poles and is covered with felt. Finally there is a roof made of felt set on narrow laths. There is an opening at the top to let out the smoke. The whole tent is bound on the outside with ropes to keep the felts in position, and with a stove inside forms a warm, semi-permanent structure, although I have seen Mongol women dismantle a yurt and pack it up on camels in little over half an hour.

Inside, in the centre, there is a hearth which usually contains a stove and an open mud oven. Round the hearth there are felts and sheepskins on which to sit, very often raised a little above the level of the hearth. The villages, if the collections of easily-moved yurts can so be called, are usually placed in the smaller valleys so as to be near the source of water supply. In this region there are few rivers, but water can usually be found by digging in the larger valleys.

TWO LAMAS
One in Chinese and one in Mongol costume.

The movable nature of their homes emphasizes the truly nomadic character of the Mongols. They wander from place to place, wherever they can find fitting pasturage, especially for their herds of ponies. Everybody rides, even the women and children, and the men are never truly happy unless they are in the saddle. When the pasturage grows poor they must therefore move the site of their villages, and that is easily done.

Mongol Ponies.

Their ponies are worthy of a brief mention. They are very sturdy great-hearted little beast. I still remember with joy the one that was lent me. He was a little chestnut, just over thirteen hands. The Mongols told me he was a lassoo pony, of which a word in a minute. He had, I was told, an objection to anything being in front of him, and this I found was

very true, and I had many excellent gallops on him. In Mongolia if you meet a stranger you at once offer to race your pony against his, and although I could never pretend to put up even a good fight against Mongol horsemanship, my little chestnut saw to it that I was not disgraced utterly. Why he had been chosen as a lassoo pony was easily discernible. The Mongols use a noose at the end of a pole, and drop this over the neck of the pony they wish to catch. They then, as it were, play him. This needs skill and speed on the part of the pony the lassooer rides, and I found my pony always tried to gallop a neck ahead of any beast near him and always to go on the outside so as to cut him off.

Horse God Temple.

The horses are the most important feature in the life of all the Mongol men. They keep sheep, but these are looked after by the children. The men look after the herds, keep them in the pastures, and protect them from wolves which are numerous on the plains. To-day in Inner Mongolia there is a noticeable lack of herdsmen because about two-thirds of the men become Buddhist lamas, and leave their families to retire into monasteries, although the religious life does not always cut them off from the world. Some earn their living in most secular manners, and we met quite a number of them looking after caravans. Before I describe the social customs of the Mongols it may be of interest therefore to describe briefly a monastery which we visited. It was known by the Chinese name of Horse-God Temple, and formed quite a large village, the only permanent buildings for many miles. It was built compactly of stone, and with its walled courtyards, its white colouring and its general appearance—rather that of a fort than a monastery it—presented a strong contrast to the impermanent villages of the laity.

The lamas in this temple were an unattractive crowd. Many of them were only schoolboys, and none of them appeared ever to wash, but then cleanliness is not one of the virtues of the Mongols. They have no duties or occupations beyond religious exercises, except in those cases where the monastery is not rich enough to support them and they have to earn their own living. This particular monastery was sufficiently well off to keep a singularly unattractive crowd of monks in idleness. One of the most repulsive individuals, at least when viewed externally, was an incarnation of a high order. The crowd of monks were a great contrast to many others whom it was my good fortune to meet at other times, but it is unfortunately true that on the whole Buddhist monks, both

A MONGOL BRIDE.
Notice how the features are European rather than Chinese.

in Mongolia and Tibet, are a turbulent crowd. The ritual of the monastery contained little that was of interest to us in our work, so we only spent an afternoon there watching a " service."

The next day we rode to a little village where a wedding was in progress, which may be considered to be typical of the ceremonies among the wealthier of the nomads in central Asia, both Mongols and Turks. In this case both bride and groom were only seventeen. The arrangements for the prospective match were made by professional matchmakers, and the girl was kept in complete ignorance of the whole matter. Messages were sent to her father, who hesitated first of all because he was not sure whether the suitor was of pure Mongol blood and whether his moral character, or rather that of his family, was sufficiently high. He was, as a matter of fact, suspected of having relations who smoked opium. It was proved, however, that he was the son of a Mongol woman, and not of the Chinese wife of his father, for the Mongols are polygamous, and the opium question was waived, since the boy himself did not smoke.

She was not told.

The bride only began to suspect that something was happening when she saw that there was an unusual amount of sewing going on in her father's tents for, as she belonged to a wealthy family it was, of course, necessary that she should have a magnificent trousseau. Meanwhile she went on a visit to some friends, in accordance with the Mongol custom which makes

it necessary that a girl should be away from home during the wedding preparations. Her mother happened to be ceremonially unclean as she had had a child within the last two years, so another woman was chosen to act as "mother."

Enter the Bridegroom.

When all the preparations for the wedding were complete the girl and her "mother" returned to the village, where they were met by a girl who covered the bride's head with a blue veil and conducted them to a yurt which had been specially prepared for them. Meanwhile the rest of the village feasted, while the girl spent most of the night in tears. Next morning she was awakened by her girl friends, who brought tea and cakes and comfort. During the morning the bridegroom rode over from his home. He rode a white charger, and his saddle and bridle were decorated with silver and with red silk trappings. His escort, which consisted entirely of men, were also lavishly mounted. They were welcomed by the bride's family and escorted to the guest tent.

A MONGOL OFFICIAL AND HIS FAMILY
Photographed in their tent.

Etiquette demands that a strict order of precedence should be observed in entering this tent, and a—to western eyes—somewhat humorous interlude now took place, everyone telling his neighbour to take a higher place, the neighbour insisting that he was really less honourable. After an hour or so spent in the distribution of courtesies everybody was got into the tent in exactly the order which everybody knew beforehand they would enter, but still courtesy demands such haggling. Then a feast again took place and after the spokesmen on both sides had their tongues well loosed by drink, the bridegroom's supporter made a long and eloquent speech on the advantages of the match and suggested that the negotiations for the bride-price were now complete. It is not good form, however, for the bride's party to yield so easily, and the bargaining continued for a long time until, no doubt under the influence of the lavish good cheer provided, an agreement was reached.

Each side now presented a ***hatyk*** to the highest member of the other side. A hatyk is a silk scarf which is used on all ceremonial occasions throughout Mongolia and Tibet. It is used when a visit is paid, when a favour is asked and when certain bargains are ratified. We were, for instance, presented with hatyks by one or two of Stevenson's patients, and hatyks were exchanged between us and the officials on whom we called on one or two occasions.

During this ceremonial bargaining—for, of course, everything had really been settled long before the women of the bride's party went to fetch her—they carried her along while her girl friends clung to her skirts and pretended to try to detain her. Her entry into the guest tent is signalized by attention being for the first time centred on the bridegroom; up till now he only takes his proper order of precedence, and as, in the case I am describing, he was only seventeen, he was practically the junior of the assembly. The women belonging to the bride's family now stripped him of his clothes and clothed him in new ones, thereby showing, it is said, that they have accepted him as a member of the family.

Fetching the Lady.

He and his party then rode home, but before they went the groom was again caught by the women and girded with bow and arrows, which he had brought along but which had been taken away from him and left at the door of the yurt before the feast began. As soon as he had gone the men of the bride's family came for her and a great struggle ensued. The girls clung to the bride and sewed their skirts to her belt,

but the men seized her and lifted her out of the belt and shut up her girls in a yurt. She is now called the "unbelted," a name which is properly applied to all married women. She was clothed in a red cape, an elaborate head-dress and a veil. Then she was lifted on to her horse. She has to sit in the saddle for a moment – no light task as, owing to the general turmoil, the horse always becomes restive and kicks and rears.

The bride was then put into her travelling cart and driven to her new home. At every village on the way she stopped and had something to eat and drink, and when close to her destination she was mounted once more on her horse, supported by one of the menfolk on either side. She was met by two of the bridegroom's party who rode out a hundred yards or so to meet her. I have, I think, mentioned how the Mongols will ride the shortest distances rather than walk more than a few yards.

All the party dismounted before the house of the bridegroom's father, where they were received by the womenfolk; the two most important escorted the bride to a table behind which the bridegroom and his sponsor were seated. The bride was led to the bridegroom's left and given a large silver bowl of milk by the sponsor. Milk is the symbol of purity and faith, and the bride drinks milk before the wedding ceremony, and when she reaches her new home, to show that she is pure.

Feasting Begins.

After the bridegroom and his sponsor had *kow-towed* to heaven the bride was led to a new yurt which had been specially put up for her, in which all the groom's party were assembled. She presented each with a hatyk and a mat, which is only used at wedding ceremonies. She next visited her father-in-law and his wife and *kow-towed* in front of them. The lady presented her with the head-dress which is worn by all married women on ceremonial occasions and her father-in-law gave her horses and jewels. She then went to her own yurt to rest.

The guests meanwhile had another banquet and before this was finished the bride, still wearing the red cape and attended by her sister-in-law and the most important ladies, presented each with a hatyk.

That night there was another banquet, which lasted from ten o clock till two in the morning. During the progress of this the bride presented each guest with a small cup of wine, bowing low as she presented it. Special musicians were employed to entertain the company, who are supposed to pay them and also to tip the servants liberally.

The marriage was, formally at least, consummated that night, the bride's "mother" sleeping on the floor of the tent occupied by the bridal pair. Next morning, and for the next three days, the bride rose early to serve her father-in-law and brother-in-law with their morning cakes and tea. The second day after her arrival in her new home the bride's hair was specially done and her head-dress put on, and she was allowed for the first time since the ceremonies began to go out unveiled.

Twenty-three-day Banquet.

That day another banquet was held in the afternoon, the bride again served wine and then parted from her relations. Once more ceremonial struggles took place, and the bride was carried by her new ladies and placed on a bed and her skirts weighed down with stones to prevent her escape.

As this was an important wedding the bridal feasts were kept up for no less than twenty-three days. Guests kept arriving and a new banquet was always being prepared in their honour. The bride's father was expected on the third day, but sent an excuse that he was in mourning and sent a lama to represent him. With the lama three sheep, cooked whole, were also sent. This was to show that the bride was a person of independent means, and not dependent on her new family for food. She handed over the sheep to the household servants to show that they were her own people now and could be trusted to look after her interest.

So at the end of twenty-three days the wedding feast ended and the bride settled down to the humdrum life in the yurt of her husband.

BUTESIN PICRATE, A NEW ANAESTHETIC ANTISEPTIC.

This newly synthesized substance is claimed to be both a local anaesthetic and an antiseptic. Chemically it is the normal butyl ester of para-amino-benzoic acid, and is a yellow solid with no odour and a slightly bitter taste. It dissolves in water and organic solvents. An extremely weak aqueous solution flooded into a rabbit's eye so numbs it that a pencil may be drawn across the cornea without sign of winking for fifteen to twenty minutes, after which time the eye recovers its normal condition. The same solution is an effective germ-killer, killing, for example, *Staphylococcus aureus* in five minutes.

Recent Developments in Science.

A Review by J. Riley, B.Sc.

From time to time we shall publish a general view of developments in science, but it has not been found practicable to devote a set amount of space to the feature in every issue. Readers may however rest assured that all important advances will be treated in articles independent of these short reviews.

THE appearance of the De Forest phonofilm, which was undoubtedly the most interesting exhibit shown at the Physical Society Exhibition which was recently held at the Royal College of Science, marks a considerable advance in the science of cinemaphotography. The problem of supplying a motion picture with its original accompaniment of speech and other sound has attracted the attention of inventors for a number of years. The early attempts at solving this problem were only partially successful because they failed to secure a perfect synchronism between the movement and the sound.

The "cameraphone" was the first of these attempts. This consisted of playing a record upon a phonograph at the same time that the picture was being shown. The novelty of the combination was sufficient to give it a temporary popularity. Unfortunately, the record and the film were usually made by different artistes upon different occasions, so that it was impossible to keep the two in step with each other.

The faults of this pioneer attempt were partly overcome by Edison, who invented what was known as the "kinetophone." This secured much better results, for the simple reason that the motion picture and the phonograph record were both made at the same time. The experiment was still not wholly successful, since the record and the picture were reproduced by different instruments, which it was impossible to keep in perfect time with each other. It was therefore abundantly clear that the talking film would only reach perfect success when both sound and picture were reproduced by a single means.

The De Forest Film.

Dr. Lee de Forest has solved the problem by adopting the method, previously used by Ernst Ruhmer and other experimenters, of making the cinema film serve the double purpose of recording both the picture and the sound. In the process which he has so successfully developed, the sound record appears as a series of fine lines which appear along the edge of the ordinary one-inch film which is in common use in cinema theatres. There is thus nothing uncommon in the type of film used, which can be shown by means of a standard projector. Nothing need be said about the picture itself, which is produced and reproduced in the usual way. We can confine our remarks to describing the making of the sound record, and its use in producing the sounds which convert the ordinary film into a talking motion picture.

In the making of the film the sounds are received by a microphone which controls the light given out by a helium lamp of special design. This lamp is called a "photion." It is very sensitive, and responds immediately to every variation in the current from the microphone. Its rays are markedly actinic, and they act strongly upon the edge of the undeveloped film, upon which they are directed through a fine slit.

New Cell.

When the film is being shown the photographic record is converted back again into sound by means of a highly sensitive photo-electric cell, similar to the selenium cell of which so much has been heard. The actual cell used consists of a screen of thalofide (thallium oxy-sulphide). As the film moves, it passes a fine slit through which light is directed from an incandescent lamp. This light shines upon the photographic record which controls the amount of light which passes through the film and falls upon the thalofide screen. The electrical resistance of the thalofide varies according to the intensity of its illumination. This variation of resistance is responsible for a corresponding variation in the current which is passing through the screen. The actual fluctuations produced in the current are exceedingly small, but after several stages of valve amplification they are sufficient to enable them to work a loud speaker.

The demonstrations at the Physical Society Exhibition were sufficient to show that the reproduction of sound was quite satisfactory, and it should not be long before the talking film comes into common use in our cinema theatres. The only difficulty that still remains to be overcome is that of distortion. The amount of distortion in the films shown was not serious, but it seemed to be most marked in the speech by President Coolidge, in which his American accent was much exaggerated. This is a serious fault, in view of the large number of American films which are shown in England, but it is almost certain that further

experiment will result in considerably reducing the distortion, even if it cannot be wholly eliminated.

NIGHT VISION.

An interesting discussion took place at the January meeting of the Ophthalmological Section of the Royal Society of Medicine upon the subject of night vision. An account of the subject is given in a brief article by Professor S. Russ, which appeared in *Nature* on 28th February. It is a well-known fact that individuals vary considerably in their ability to see in the dim light of night-time. Some people appear to be almost blind in a night of average darkness in which other folk have no difficulty in finding their way about. It is also common knowledge that wild animals can find their way about at night much more readily than human beings. It is true that in the case of wild animals the sense of sight is assisted by a strong sense of smell. In the case of night owls, however, whose power to see " in the dark " is proverbial, it is sight alone which directs them. A curious point mentioned by Professor Hobday in the course of discussion was that Australian horses were employed for night work during the war in Palestine, because they did not suffer from " night blindness."

Professor Russ's article is mainly concerned with an account of experiments conducted by Dr. J. C. Mottram and himself during the war, upon the best conditions for night vision. It requires little knowledge to realize that it is impossible for anyone to see in absolute darkness. Vision is only possible when there is some light. To see in the dark means scientifically to see in a dim light. What we wish to know, therefore, is why some people and some animals see better in dim light than others.

Professor Russ's Experiments.

The experiments carried out by Professor Russ and his co-worker do not supply a complete answer to the problem. But they do throw considerable light upon one important factor. They show the extremely important part which is played by the transparency of the media of the eye in affecting nocturnal vision. It is obviously the light that reaches the retina that is alone able to help us to see. But on its way to the retina light has to pass through the cornea—the watch-glass of the eye—the eye lens, and the aqueous and vitreous humours—the jelly-like substances which form the interior of the eye. Professor Russ was successful in showing that these are never perfectly transparent. They never let through the whole of the light. They are most transparent, however, and let through most light, in the cases of those animals which see best " in the dark."

The experiments which Professor Russ conducted were of a most direct character. In each case experimented upon, a fresh, enucleated eye was prepared by cutting away a small portion of the retina at the back of it, and fitting over the aperture a thin quartz plate which was to serve as a window. The eye was then mounted in front of the slit of a quartz spectrometer, which was used to measure the light which filtered through the eye from a cadmium arc. This includes a considerable range of ultra-violet as well as visible light. As was expected, all the eyes absorbed a good deal of the ultra-violet light. There were, however, outstanding differences between the different eyes examined.

The range and amount of light which reached the back of the eye was least in the case of the human eye—three of which were examined. The range of light which filtered through the eye was greatest in the case of the great eagle owl, the eye of which enabled the whole of the visible spectrum, and a considerable portion of the ultra-violet light, to reach the retina. Next came the eye of the tiger, then that of the lion, and then that of the lioness, whose eye was still much more transparent than a human eye. The eye of an ox was about as transparent as the human eye. A cat's eye was shown to closely resemble that of the tiger. It is clear that the nocturnal animals are endowed with eyes that are transparent to a certain range of ultra-violet light, and this is undoubtedly a valuable aid to night vision.

TRANSPLANTATION OF EYES.

The science of the eye has also recently been the subject of discussion on account of reports of extraordinary experiments in Vienna in connexion with the transplanting of eyes. Walter Finkler has actually claimed that he has been able successfully to exchange the entire heads of various insects. Dr. Koppanyi, of the Biological Institute at Vienna, is more modest, and confines his claims to the successful transplanting of eyes.

The whole subject deserves mention in view of the fact that similar claims are bound to be made again. It is worth while, therefore, to make certain of what has, and what has not, been achieved in the experiments which have been carried out. Undoubtedly eyes have been transplanted; but they are useless for purposes of seeing. Dr. Blatt has made eye transplantation experiments upon four hundred freshwater fish, forty chickens, and eighty rabbits. Needless to say, anaesthetics were used in every case. Anatomical healing took place in the case of twenty-six fish and two rabbits, but not in a single case of a chicken.

In his experiments, he took special precautions to ensure that the eyes fitted the sockets. The eye muscles and optic nerves were also carefully cut, so as to bring the cut ends as closely as possible into contact, after the transplanting had taken place. After healing, the eyes moved slightly in a short, irregular way—thus showing that the muscles had become knitted together. But the movements were totally unlike the deliberate movements of the seeing eye.

The eyes, in fact, remained totally blind, as was proved by a number of tests. They failed to respond to the stimulus of a sudden flash of light, and they were of no use in guiding the animal's movements. The conclusion of the experiments, therefore, is that, while it is possible to transplant eyes, there is no evidence at all that sight is ever recovered.

ARTIFICIAL INCUBATION.

THE Journal of the Royal Society of Arts recently contained two suggestive articles, by Mr. Llewellyn B. Atkinson, on "The Scientific Principles of Artificial Incubation," which are an excellent reminder of the assistance which scientific experiment can render in the solution of the practical problems of everyday life. The use of incubators for the hatching of eggs is by no means so recent an invention as we are apt to think. It is true that artificial incubation in Europe only goes back a matter of just over forty years. But in Egypt, China and Malay, the artificial method has been in successful use for thousands of years. Further, the crude incubators of these Eastern people are far more successful practically than are those of our own country. It is claimed that with Chinese incubators 95 per cent of the fertile eggs are hatched. European and American incubators rarely exceed an average hatching efficiency of more than 55 per cent, although, of course, individual hatches will reach an efficiency of 85 or 90 per cent. The general opinion is, however, that the Western incubator is far less efficient than the mother hen. Mr. Atkinson set himself the problem of discovering why this should be the case. In order to solve this he inquired in what ways the conditions inside the various types of incubator differed from those underneath the sitting hen. His conclusions were that the air under the incubator is too dry, and that the egg is kept at too uniform a temperature. In the nest of a sitting hen the conditions are quite different. The bottom of the egg is much cooler than the top of it that is immediately underneath the hen. There is, in fact, a difference in temperature of between 14° and 20° F.

Imitating Nature.

In order to imitate the natural conditions, Mr. Atkinson covers the upper surface of the eggs with a very thin sheet of india-rubber. When this is done in a hot-air type of incubator, it is quite easy to get a difference in temperature of 14°F. between the top and bottom of the egg. The rubber sheet serves the further purpose of preventing the too rapid evaporation of moisture from the eggs, and of keeping the amounts of moisture and carbonic acid gas round the eggs as near as possible to those which operate in the hen's nest. By using this modified method, an incubator which had usually given no more than 55 per cent efficiency hatched 95 per cent of the fertile eggs.

DISCOVERY APPEAL FUND.

April – December 31st, 1924.

	£	s.	d.
Subscriptions acknowledged in May, June, August, October and December Numbers	275	16	0
A. Englehart, Esq.	1	1	0
Donation before issue of the Appeal		7	7
	£277	4	7

	£	s.	d.	£	s.	d.	£	s.	d.
Debt on Administrative Expenses, 1923							14	2	4
Bank Charges, 1923					9	2			
Deduct Cheques unused ...					1	10			
								7	4
Liabilities to Mr. John Murray for 1924							150	0	0
Cheque Book								5	0
Administrative Expenses of Committee, 1924				40	19	4			
Deduct Publisher's Commission, 1923		3	6						
Receipts from Benn Brothers, April-December, 1924 ...	10	13	9						
				10	17	3			
							30	2	1
Balance in hand 31st Dec. ...							82	7	10
							£277	4	7

R. S. CONWAY,
Hon. Secretary.

]EDITOR'S NOTE.—The DISCOVERY Appeal Fund was raised in order to meet the liabilities incurred by the Trustees before the publication was taken over by Benn Brothers, and to provide a sum for the administration expenses of the Committee.]

SCIENCE LIBRARY.

FROM 2nd April until further notice the Science Library will remain open until 8 p.m. on Thursdays and Saturdays. After 6 p.m. entrance to the library will be through the Imperial College of Science and Technology in Imperial Institute Road.

Cyclops.

By Sir Arthur E. Shipley, G.B.E., F.R.S.

In both salt and fresh waters the Copepoda are one of the most important sources of food for fish They are common in many ponds and ditches and are fascinating objects to watch under the microscope.

THERE is a large group of small crustacea known as Copepoda, a word derived from the Greek, which means the " oars as feet." Amongst them is a small creature known as *Cyclops* which, like *Daphnia*, is often vaguely referred to as a "water-flea." It is a small animal hardly a millimetre in length. Its body is sometimes compared in shape with one half of a split, rather longish, pear. These creatures are exclusively freshwater, and do not even penetrate into brackish streams. They are common enough and very abundant in the weeds of lakes or pools or slow-flowing streams. The late Geoffrey Smith records taking large numbers of *C. fuscus* and *C. strenuus* in the weedy inshore waters of Grasmere, but the genus seems to be practically ubiquitous in fresh water, and some species are taken on the surface waters far from the shore. Others, again, dwell in subterranean springs and are occasionally brought to the surface by artesian wells. In such places they have, like many other animals that live in the dark, lost their eyes and lost their colour. If one examines a *Cyclops* under a low power of the microscope one will see that it moves about by the sharp jerky motions of its antennae, and more steadily and more uniformly by the rowing of its feet.

The Head.

There is no valve-like shell such as we find in *Daphnia*. The body consists of a large rounded head which may terminate in a process or spine, and in a thorax consisting of, in the male, five rings or segments, and in the female four, two having fused into one in this sex. The abdomen, which represents the narrow end of our split pear, ends in two symmetrical processes together called the caudle fork, and each process bears a number of feathered hairs. The appendages of the head are as follows :—(*i*) The first antennae. These are large with eight to seventeen segments, and in the male they serve as a clasping organ to hold the female when the eggs are being fertilized. These antennae in both sexes take some part in swimming. (*ii*) The second antenna is small and insignificant. Then on each side of the mouth is (*iii*) a large and strong mandible, somewhat squarish in shape, and bearing numerous little teeth. This takes a large part in crushing the food of the *Cyclops*. It bears a small, sensory organ or palp, but in the *Cyclopidae* this is extraordinarily small. Following on the mandible come a pair of (*iv*) first and (*v*) second maxillae. The second of these is split into two conspicuous halves. These five appendages constitute the normal appendages of the head on a normal crustacean.

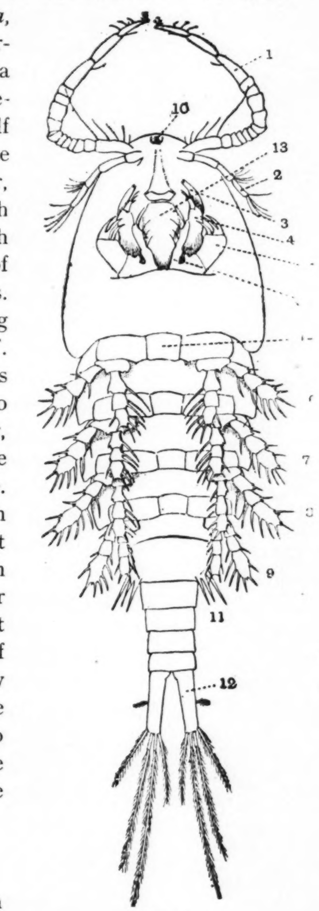


FIG. 1.
VENTRAL VIEW OF MALE *CYCLOPS*.
1. Antennule. 2. Antenna. 3. Mandible. 4. First maxilla. 5. The two halves of the second maxillae sometimes called inner and outer maxillipedes. 6-9. First-fourth thoracic limbs. 10. Eye. 11. Bristles near male generative opening. 12. Caudal fork. 13. Mouth. 14. Copula or plate connecting the right and left limb of each pair.

Conjoint Legs.

The head is not separated from the thorax by any neck or constriction. On the first four segments of the thorax there are paired appendages which are shaped something like an inverted Y. These limbs are flattened and consist of short broad joints bearing many spines. The right and left legs of any pair are further joined together by a flattened plate so that when one moves the other has to move. It is these limbs that have given rise to the German name of oar-footed crabs, which is that nation's common name for the whole of the Copepoda. When the whole eight move simultaneously the little *Cyclops* darts through the water. On the other hand the swimming movements of the first antennae produce a slow and

gliding motion. All this time the maxillae are producing a sweeping current in the neighbourhood of the mouth, bearing towards it the suspended food.

The first abdominal segment in the female is fused with the last thoracic, which bears only the merest rudiments of limbs. On it open the oviducts and the small sac which is destined to receive the spermatozoa of the male. There is no heart in *Cyclops*, and the movements of the blood are brought about by the

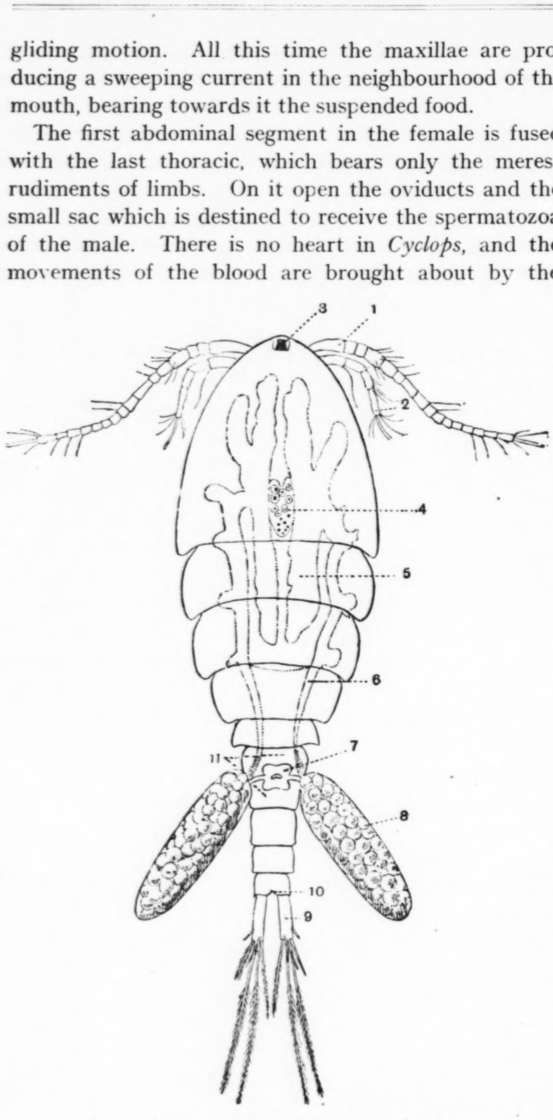


Fig. 2. DORSAL VIEW OF FEMALE *CYCLOPS*.
(Partly after Hartog.)

1. First antenna. 2. Second antenna. 3. Eye. 4. Ovary. 5. Uterus, *i.e.*, pouch of the oviduct into which the eggs pass before being shed. 6. Oviduct. 7. Spermatheca or pouch for receiving the spermatozoa of the male. 8. Egg-sacs. 9. Caudal fork. 10. Position of anus. 11. Compound segment, consisting of the last thoracic (bearing the genital opening) and the first abdominal.

movements of the various parts of the body. There are a pair of glands which act as kidneys lying in the head, and opening at the base of the second maxillae. The alimentary canal is simple, and when looked at from above is rather occluded by the uterus in which the eggs rest for a stage on their way to the outer world.

The nervous system consists of the usual big ganglion above the mouth, a nerve-ring round the mouth, and a chain of ganglia running along the middle of the under or flattened surface. I do not know how many ganglia there are. There is a single median compound eye, probably the result, as in *Daphnia*, of the fusion of two larval eyes. It is from this feature that the creature has taken its name. There are two races of *Cyclopes*: one of them helped Vulcan at his forge in the heart of volcanoes, especially in Mount Etna and on Lemnos. They were so strong that Kronos confined them underground, but Zeus set them free, for they furnished him with thunder and lightning. Later they appeared as the builders of cities constructed of huge stones, which form of architecture is still known as Cyclopean. The second race mentioned in the Odyssey were a "froward and lawless folk," as Homer tells us, who lived alone in caves with huge herds of sheep and goats. Like the others, these had only one eye. This race seemed to be in some way connected with Neptune and the forces of the sea. There is no kind of auditory organ, but certain of the hairs on the antennae seem to be olfactory in nature.

Propagation.

The ovaries are in the middle of the front part of the body, and the ovaries at each side tend to fuse together as they do in the crayfish and lobsters. They open into two large uteri, which are distinct from one another and occupy a considerable portion of the inside of the body. For a time the eggs rest in them, and then pass back through the thoracic segments along the crinkled oviduct, which opens just behind the last pair of paddle-like appendages. They pass out into two egg-sacs, and these egg-sacs, often most brilliantly coloured, are eminently characteristic of the group Copepoda. They occur even in those forms which have been most deeply modified by parasitism. Each egg-sac contains four or five dozen eggs which are compacted together by a mucus secreted by the female. In the same segment there is a small squarish chamber which opens in the middle line to the outside, and by two lateral ducts into the ovisacs. This is the spermatheca or pouch which, after fertilization, contains the spermatozoa of the male, and the side ducts probably indicate that the eggs are fertilized in the egg-sacs.

We have seen that the *Cyclops* consists of five segments fused together as the head, five segments of which four bear paddles in the thorax, and four segments in the tail, making fourteen altogether. Thus the last segment of *Cyclops* corresponds in number with the first segment of the abdomen of a crayfish. When the eggs hatch out they produce a larva of a form which is eminently characteristic of the crus-

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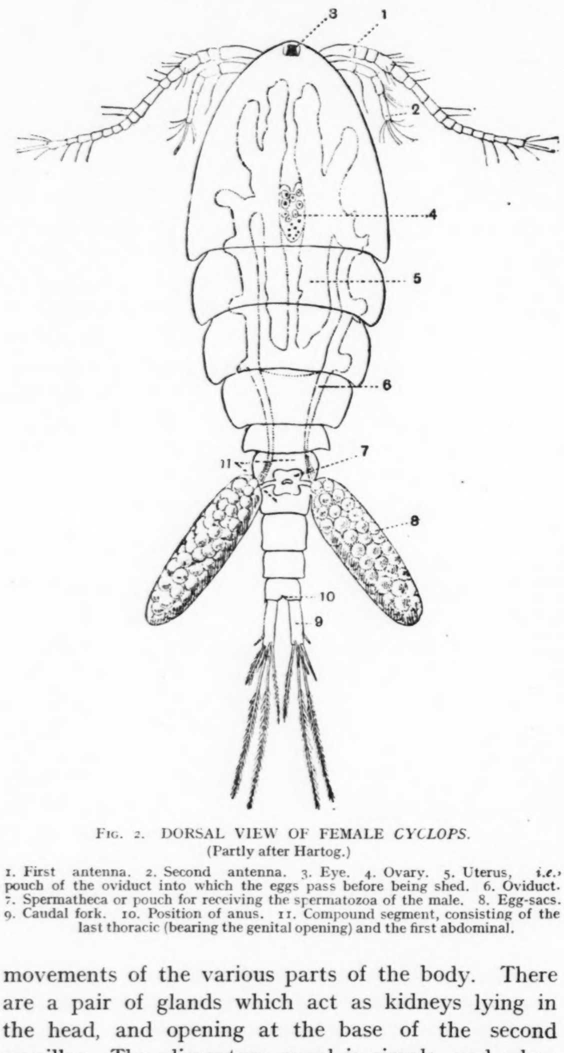

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tacea, although it is not common in the bigger and larger forms.

This larva, called a Nauplius, is a tiny creature with three segments only bearing three pairs of limbs which correspond with the first and second antennae and the mandibles of the parent form. It is a case of arrested development: the Nauplius has stopped short too soon, and in the course of time it will gain its full complement of segments. Thus for a time the young larval *Cyclops* represents the first three segments of the adult. When they were first discovered – and this was in the case of the group we are dealing with – they were believed to be adult, but it is now known that they cast their skins several times and add successive segments until the complete number of fourteen has been produced. The new segments always appear between the last-but-one and the last segment of the abdomen or tail.

Copepoda are extremely common in the sea, and in the Baltic region certain forms of the group are found in brackish water. Many of the marine forms have amazing beauty. Their hairs are produced into the most wonderful feather-like structures. They have adopted most gorgeous colour schemes, the colour being generally confined to certain oil drops symmetrically arranged which have taken on the most brilliant hues. They are as beautiful as birds of paradise, or as Mr. Brock's fireworks at the Crystal Palace. Yet their glory is concealed, for you can see them only with the microscope. It seems a pity that so much splendour and radiance is lost to the world.

The number of copepods in the sea is prodigious. They are by far the most abundant of all the metazoan (animals other than protozoa) animals which live in the ocean. There may be more unicellular organisms but these are so small that many thousands of them would be required to make up the bulk of an average-sized Copepod. Copepods in their turn are smallish creatures about one-sixteenth of an inch in length. They occur in all the waters of the globe, and hardly ever is a tow-netting taken up which does not include some members of this group. A few are found feeding on the mud, but the great bulk of them are pelagic, living near the surface of the sea. Most of them live on an average only seven or eight days. It has been calculated that in ten cubic metres of the Baltic Sea there is produced annually 8,866,000,000 of these little crustaceans, and as their numbers do not increase, presumably the same number are eaten every year. These calculations, however, are rather speculative. But they may be checked by the stomach content of the herring, which lives very largely on Copepods. They are extremely nutritious and contain 59 per cent of proteids, 7 per cent of fats, 20 per cent of carbohydrates, 4.7 per cent of chiten (*i.e.*, their outer skeleton) and 9.3 per cent of ash. In nutritive value they are equal to the oyster, whose chemical composition most closely resembles theirs. They are positively heliotropic (*i.e.*, they make their way towards the light). When taken and boiled they turn a vivid red like lobsters, and if spread on hot buttered toast and eaten with a little salt and pepper they are as palatable as shrimp paste; indeed, they would make a very good food for human beings were their capture for that purpose a commercial proposition. They are emphatically a large source of food of fishes.

If on a voyage you tie a piece of bolting cloth loosely to the bath tap which introduces the salt water into the bath, in a very short time you will find a deposit or paste at the bottom which in the main consists of Copepods.

They are not equally abundant in fresh water, but still they are common enough, and Brady, writing seventy-five years ago, tells us that "the ordinary water with which the inhabitants of London are supplied for domestic purposes often contains them in large quantities."

Books Received.

Down the Grand Canyon. LEWIS R. FREEMAN. (Wm. Heinemann Ltd. 25*s.* net).

Ancient Egypt. 1925. March. Part I. (Macmillan & Co. Yearly 7*s.*; quarterly 2*s.*).

Physical and Chemical Survey of the National Coal Resources. No. 4. *The Lancashire Coalfield: The Ravine Seam.* Part I (H.M. Stationery Office. 1*s.* 6*d.* net).

Introductory Geology. LOUIS V. PIRSSON and CHARLES SCHUCHERT. (Chapman & Hall. 20*s.* net).

The Mechanical Investigations of Leonardo da Vinci. IVOR B. HART, B.Sc., Ph.D., F.R.A.S. (Chapman & Hall. 16*s.*).

What I Believe. BERTRAND RUSSELL, F.R.S. (Kegan Paul. 2*s.* 6*d.* net).

Practical Advice to Inventors and Patentees. C. M. LINLEY. (Sir Isaac Pitman & Sons Ltd. 3*s.* 6*d.* net).

The Common Sense of the Theory of Relativity. PAUL R. HEYL, Ph.D. (Bailliere, Tindall & Cox. 5*s.* net).

Population. A. M. CARR-SAUNDERS. (Oxford University Press. 2*s.* 6*d.* net).

The Religion of a Darwinist. SIR ARTHUR KEITH, F.R.S. (Watts & Co. 2*s.* net).

The National Physical Laboratory. Report for the Year, 1924. (H.M. Stationery Office. 8*s.* 6*d.* net).

A Survey of Physics. MAX PLANCK. (Methuen & Co. Ltd. 6*s.* net).

The English-Ido Dictionary. L. H. DYER. (The International Language Ido-Society of Great Britain. 10*s.* net).

The Rigid Airship. E. H. LEWITT, B.Sc., M.I.Ae.E., A.M.I.Mech.E. (Sir Isaac Pitman & Sons. 30*s.* net).

North Manchuria and the Chinese Eastern Railway. 1924. (C.E.R. Printing Office).

Chemistry to the time of Dalton. E. J. HOLMYARD. (Oxford University Press. 2*s.* 6*d.* net).

The Romance of the Fungus World. R. T. and F. W. ROLFE. (Chapman & Hall Ltd. 12*s.* 6*d.* net).

Book Reviews.

Practical Surgery Illustrated. VICTOR PAUCHET. Vols. I and II. (Ernest Benn Ltd. 18*s*. 6*d*. net each).

The title of these volumes might with advantage be changed to Pauchet's Practical Surgery, as no doubt it will be known, in accordance with the customs of medical students in this country. The author makes no claim to write a textbook of clinical surgery, but with admirable clearness gives illustrations of actual cases, and the results of his own ripe experience.

The work has been described as an atlas, on account of the profusion of excellent sketches and diagrams, illustrating the actual operative proceedings in stages, with amazing clearness and detail. It is, however, much more than an atlas, and the author's descriptions of each subject contain more surgical wisdom than it would seem possible to convey in this space. One feels that surgery for Victor Pauchet is a priestcraft, and he treats it with proper sincerity and enthusiasm, setting forth the reasons for his belief. Some of his teaching, as in intestinal stasis, which is dignified as Lane's Disease, will not find general acceptance, but his able justification may well bring fresh converts, by reason of the clearness and simplicity of its exposition.

To us, one of the most striking features of the book is the extensive use of local and regional anaesthesia. In this country the protagonists of ether and chloroform have so monopolised the stage for their controversy, that local anaesthesia is largely neglected, in spite of the apparent disadvantage of inhaled anaesthetics in a climate where the entire population suffers from intermittent respiratory infections.

It may be, as an anaesthetist said, that we are singularly blessed with skilful administrators of volatile anaesthetics, or it may be that our patients have not the extra confidence and stoicism necessary for major operations under local anaesthesia. If so, they have changed since the days of Ralb and his friends. Perhaps our surgeons have not the necessary patience, and gentleness, and this point is well emphasised by Pauchet.

The section on the treatment of suppurative appendicitis appears somewhat ingenuously in the English language, with a diagram of drainage tubes which would terrify the most ardent opponents of closure of the abdomen, but perhaps this is not a controversial subject in France.

The series contains some inevitable defects. There is some repetition. It is without an index, so difficult to use for reference, and there is no bibliography of the numerous papers quoted. One would wish also that the translator had interpreted for us such difficult terms as "azotaemia," and "millieames of destroyed emanation."

Crystals and the Fine-Structure of Matter. By FREDERICH RINNE. University of Leipsig. (Methuen. 10*s*. 6*d*. net).

The crystal has been called the No-Man's Land between chemists and physicists. This book covers a general interpretation of atomic form as deduced from crystal structure. We do not think that the author has struck a happy proportion between the work of British scientists and the less important continental workers whose contributions to knowledge are unduly stressed.

The Romance of the Fungus World. By R. T. and F. W. ROLFE. (Chapman & Hall Ltd. 12*s*. 6*d*. net).

Do you know the difference between a mushroom and a toadstool? The reviewer admits at once that he does not, and that to him all fungi other than those which appear in sauces at good restaurants are regarded as certainly dangerous, probably deadly. According to the authors this is a purely British trait, "fungophobia." Yet I doubt it; surely it is "Safety First." Now it so happens that I, like many other people, like eating strange things. In France and Germany I have eaten a variety of delightful kinds of fungi and found them not only entertaining but extremely good. This book I welcomed, for I thought that it would give me a clue to a general test for edible fungi. Alas, it does not. Neither peeling, nor silver-blackening, nor any other simple rule is apparently safe. And I know that while shooting next autumn I shall find wonderful attractive-looking fungi, and once again I shall not know whether they are safe to eat or not unless I have the book by me.

However, the book is not by any means confined to the problem of what toadstools are safe eating. It gives a wonderfully readable account of all sorts of aspects of fungi: fungi in fiction, in medicine, their cultivation for food, the derivation of their names, their structure and characteristics. It is an astonishingly good and interesting book, which will appeal not only to the amateur and the student of mycology, but to the general reader.

There has not been a good general book on this subject available, and the work can be welcomed for the very good reason that it fills a want and fills it well. It is to be hoped that it will encourage investigation into a little-known subject.

The Principles of Human Geography. By ELLSWORTH HUNTINGTON and SUMNER W. CUSHING. Third edition, revised. 8vo. pp. xiv., 430, with many maps and illustrations. (Chapman & Hall. New York and London. 1924. Price 15*s*. net).

The appearance of a third edition within four years shows that this textbook has established itself already in many quarters. Though it is not in very common use in this country, and is obviously planned in the first instance for use in American institutions where the methods of instruction are rather different from ours, it is nevertheless worth noting by British teachers of geography as a clear and forcible exposition of the views which everyone connects with the name of Dr. Huntington, on the relations between human efforts and geographical "controls." A general knowledge of physical geography is presumed throughout, though the chapter on climate goes more closely into meteorological detail than is customary elsewhere in the book. What is elaborated, on the other hand, with unusual care and detail, is the effect of this and other geographical factors, which are taken separately and illustrated in their more important aspects as stimulants of human activity or as obstacles to it.

For class-work, the peculiarities of construction already noted, and still more the rather high frequency, not only of printer's errors—regrettable in a third edition—but of slips and misstatements in detail, the book is therefore not very well suited. But any teacher whose method and syllabus are not too rigidly set, and any pupil, from the fifth form upwards, who knows already enough to challenge unfamiliar statements and probe them for their real significance, will find it worth reading; not least the chapters on "Man's changing surroundings," where Dr. Huntington's special studies are, of course, concentrated, and on "Political geography" or "Man's

relation to Man." Here, for example, you may learn " how too much rain brings the Irish to America " ; " how a difference of climate led to the Civil War " ; "how good political boundaries may be bad commercially " ; or—as concerns us most nearly—" why the British Empire has grown so great," wherein tardy justice is done to the " best climate in the world " as one of the reasons why we have gone and settled in climates which resemble it. Some of us over here had been thinking that with Saxons as well as Irish it is to escape from the ills we have that we insist on going oversea.

J. L. M.

Lamarck, Darwinism and Dental Disease. By ORAN STARR, D.D.S., L.D.S. (G. Routledge & Sons Ltd. 21*s.* net).

It is impossible not to admire the thorough manner in which Mr. Starr has searched biology through and through for an explanation of the present widespread dental disease in man, and the reader who follows him in his review of creation from the very dawn of pelagic protoplasmic life cannot but be deeply impressed by the skilfulness of his arguments. Whether or no he will be convinced by them will depend on his belief in the inheritance of acquired characteristics, and his disagreement with Darwin on that point.

The conclusions Mr. Starr arrives at have been hinted at by the researches of Mr. Stanley Colyer amongst others, and are, therefore, not revolutionary ones.

The argument placed before the reader is that man has violated Lamarck's laws governing protoplasmic life, and is but expiating his guilt in the form of widespread dental disease, dyspepsia, gastritis, colitis and anaemia. These conditions, Mr. Starr points out, are absent in our fellow vertebrates that are not afflicted by the violation of the law which declares against the great and sudden change of environment occasioned by the use of cooked food.

The reader will be urged, by what is admittedly sound reasoning, to believe that the use of heat in the preparation of vegetable foods is the sole cause of man's oral debility, and that its abolition is the only road to dental health.

To quote from the author, " Without a single beneficial effect, cookery has the most direct, indirect, and complex influence upon our masticatory organs which is poisonous and degenerative to them in every regard." And again " Modern food is so altered from its natural state and is so softened and liquefied by cookery, that nothing like the same conditions prevail in our mouths as obtained in the clean and healthy mouths of animals that live upon raw foods. Our mouths open and a spoonful of liquid, or almost liquid food is placed behind our front teeth, the lips genteely closed, and he who would prove his nobility will but noiselessly form a bolus of food with his tongue, teeth and cheeks and force it on its inanimate voyage, using the mouth as little more than a pressure-chamber to force this adhesive stuff into the pharynx and oesophagus."

One would have wished that Mr. Starr had been a little more tolerant of the skilful and beneficient work on Vitamines carried out so painstakingly by such scientists as Mrs. Mellanby. Vitamines have no place in the author's philosophy, and the reader will find Mr. Starr's explanation of their non-existence a most engrossing chapter.

The author is to be congratulated on having produced a magnificent and searching treatise on the subject he has attacked and the book—although a difficult one to read—is one that will be studied with interest by the general reader and the dental surgeon.

S. W. S.

Plant-Life on East Anglian Heaths. By E. PICKWORTH FARROW, M.A., D.Sc. (Cambridge University Press. 7*s.* 6*d.* net).

Dr. Pickworth Farrow has written a book which is astonishingly interesting. Ecology is rather a forbidding name for a study of such an interesting main subject as the effect of rabbits on their plant environment. The book is of considerable importance to others besides ecologists, for it is the first careful study of this nature which has appeared. Sportsmen and landowners will profit from some of the facts thus ascertained, though in its present form the matters of interest to the landowner would have to be sorted out from matter of equal scientific value but less practical application, and all the Latin translated. It is a great pity that the author did not remember that though *Carex arenia, Pteris aquilina,* and *Solanum nigrun* mean something to a botanist, they are simply an italicised nuisance to a reader who has not got a botanical handbook in the house. Call them sedgegrass, bracken and night-shade and they become familiar. If it is necessary to compound with ecological dignity an extra page giving the English names for the Latin ones might be inserted.

The author shows how constant cropping by rabbits entirely alters the plant environment. Heather gives place to grass, flowering plants never get a chance to seed for their flowers are cropped. Why bracken clumps start up round rabbit holes a long way from the main bracken patch is explained, and many interesting factors are shown to be effects of rabbit attack or plant competition helped by rabbit attack. The reason why rabbits do not eat bracken is a point that has not been clear to the author, but I think I can help him. As a decoction of bracken or male-fern is a fine old-fashioned remedy for worms in puppies, it is probable that bracken is actively purgative to rabbits as well.

One of the most stimulating suggestions in the book, and one which will probably lead to active discussion in archaeological circles, is the idea that many of the East Anglian earthworks were defensive trenches across belts of open pasture land which had been denuded of trees and shrubs by endless cropping by domesticated herds. The author suggests that it is to the biotic influence of grazing animals and man that we owe the cleared treeless belts of the North and South Downs. Altogether an interesting and useful book deserving a wide public.

The Rigid Airship: A Treatise on Design and Performance. By E. H. LEWITT, B.Sc., M.I.Ae.E. (Sir Isaac Pitman & Sons. 30*s.* net).

The design of rigid airships is one of the sides of aeronautical engineering on which scant particulars have been available. Dr. Lewitt deals with structure stresses and design from a practical as well as a theoretical point of view. Beam stresses, temperature variations, diagonal wiring and struts are all considered and examples given of the way in which practical engineering problems may be worked out. The book is one suitable for advanced engineering courses and qualified technologists. The formulae tables and diagrams of stresses are extremely complete, and the book will undoubtedly be the standard work on the subject.

Handbook to Freshwater Aquaria and Vivaia. (L.C.C. 3*d.* net).

A very good little pamphlet by the Zoologist to the Horniman Museum, Mr. H. N. Milligan, covering a wide variety of insects, pond-life, and common reptiles. Its price puts it within the reach of the lowliest of boy students, and it is to be hoped that the L.C.C. will in future publish pamphlets of this size on other and more specialized subjects.

Practical Chemistry by Micro-Methods. By EGERTON CHARLES GREY, D.Sc., F.I.C. (Heffer. 4*s.* 6*d.*).

In practical micro-chemistry the experimenter succeeds in analysing substances by using minute quantities of material only; for him a speck suffices for a solid, a drop for a liquid. Dr. Grey shows it is possible not only to carry out analytical work by these methods, he pleads for their introduction into the teaching course and into regular practice. There is nothing at present done by the student, he declares, that cannot be done equally well by micro-methods. Small apparatus avoids waste; it enables the student to work free from danger when handling inflammable or explosive material. Obviously also it is a much cheaper way of doing things than the present one.

In the main this book follows the course of most books on analytical chemistry, but deals fully with the adaptation of known methods to small-scale work. It emphasizes their use of all known sensitive tests. This emphasis is very necessary. There is nothing new about the reactions shown on the plate at p. 65, but the use to which they have been put by the author will be a revelation to many chemists. It is claimed that by the help of this table analysis of many single metals can be carried out accurately in a very short time. On one occasion ten substances were identified in the author's laboratory in fifteen minutes. There are much valuable information and hints of this kind. The theoretical foundation of the processes described, although not omitted, is not emphasized; the book, as it professes to be, is a practical one.

Although I think that analytical chemists will welcome this book because it treats an old subject in a new way, I am not sure that many of them will agree that micro-methods might well displace those ordinarily used. The advantages of the micro-methods are obvious, but Dr. Grey is unduly optimistic in thinking that anyone could use them. The good man could use them because he is a close observer who is patient and who takes care, but these qualities are not the lot of most of those who can make reasonable progress by the older methods. It is not given to every "bobby" to be a Sherlock Holmes.

There is another point. A chemist should be trained so that the technique he acquires may help him to do original work. Now, no one could hope to do work with the precision that research demands on microscopically small quantities of material. For example, in volumetric work no real precision can be expected from a titration of one cubic centimetre. A man who can get good results in this way is a clever man in the sense that an acrobat is a clever man. But standing on one's head does not help one to the top of Everest.

On the other hand it is often necessary for an analyst to work accurately with small quantities of material — when working with precious materials, for example, or when investigating a poison case. Such a man is usually an expert. To him this book will be of value. There is a fascination, even to the lay mind, in the ease and certainty with which an expert in chemical analysis can decide from an examination of a minute portion of a substance which of many thousands of compounds the one he is examining is.

Biology. By PROFESSOR PATRICK GEDDES and PROFESSOR T. ARTHUR THOMSON. Home University Library. (Williams & Norgate. 2*s.* 6*d.* net).

Where this book sticks to its subject, the surveying and explanation of the science of biology, it is excellent, but it has a maddening trick of wandering off the point and including symbolical bookcases meant to show the relationship of sub-sciences to biology. Symbolism is very right and proper in its place, and we should not have objected to the crudities of the diagrams or the poverty of the images if they had been in a book on "Yoga Soul States after a Diet of Dried Figs" or something of a similar nature. "Has our long-laboured graphic outline of eight sub-sciences seemed but cold, dull, and 'dry'? If so, the magic of graphics (for graphics have always been magical) has not yet been realized," say the authors. This is what folk north of Tweed call "bletner" and our medical friends might call "tympanitis." It is downright exasperating to find crude phantasies of this description interpolated in a book on the general significance of biology, and it is just as irritating to the general reader with no knowledge of biology as it is to the qualified student. These dykes of irrelevance cut across the whole scheme of the book so that in place of presenting a coherent picture of co-ordinated effort, functional and purposive, we are led into a bog of biological mysticism. The student or the general reader will seek in the book for directional guidance. He will buy it in order to find out the general ideas of biology as we know it to-day. He will conclude that either biologists themselves have no idea of their subject, or that the authors of this book cannot give a clear statement. The moment they abandon fact and approach theory, vision is dimmed and their words fail to convey whatever images they had in mind.

R. McS.

Scientific Research and Human Welfare. By FRANKLIN STEWART HARRIS, Ph.D. (Macmillan. 12*s.* net).

An unpretentious little attempt to draw the attention of the American high school student to the fact that scientific research has profoundly influenced the world in other than the military art. The price asked for the book, which is not illustrated, commands attention.

SUMMER COURSES IN POSTGRADUATE MATHEMATICS.

THE second session of the summer school for post-graduate mathematics, organized by the Extra Mural Department of the University of Manchester, will be held at University College, Bangor, from Monday, 24th August to Saturday, 5th September. The object of the school, which is recognized by the Board of Education, is to afford facilities for advanced study in mathematics to teachers and others who have read mathematics for a university degree.

The following three alternative courses are proposed, each one consisting of twenty lectures of one hour each, two lectures being taken on each of ten mornings.

(*a*) "Atomic Structure and the Quantum Theory. By Professor Sydney Chapman, M.A., D.Sc., F.R.S. (Imperial College of Science, London).

(*b*) "Theory of Functions." By Professor L. J. Mordell, F.R.S. (Manchester University).

(*c*) "Higher Geometry." By Mr. H. W. Richmond, M.A., F.R.S. (King's College, Cambs.)

Details of the fees, hostel accommodation and syllabuses may be obtained from Miss D. Withington, the University, Manchester. Application should be made at an early date, as the holding of the courses depends to some extent upon the number of applications received.

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